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ROYAL ARCHITECTURAL INSTITUTE OF CANADA

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EDITORIAL

THE SEPTEMBER ISSUE of the *Journal* has reached a record for avoirdupois thanks to the Montreal General Hospital. This page is not the place for an essay on the modern hospital, but a building of such size devoted to the sick and helpless, does raise the problem of vulnerability in war. We do not know the Montreal situation as well as we do that in Toronto, but in the latter city, we have a concentration of hospitals that has given several eminent medical practitioners, and not a few laymen, cause for real alarm. In a single area, we have three hospitals with a total of two thousand seven hundred and ninety-five beds. The whole group covers several city blocks, and, as a target, could not be missed. Any attack on the centre of the city, would inevitably include the hospital area which is too hopelessly involved in the downtown street pattern to give it anything but legal "protection" under the rules of war. We can be thankful, in Toronto, that our chronic hospital is some miles away from the central hospital group, and that one thousand five hundred and twenty-four beds in the veterans' hospital are remote from targets of any importance. Obviously, nothing can be done about such concentration of beds in the downtown sections of North American cities, but in plans for the evacuation of citizens who are sound of wind and limb, some thought should be given to the much more complex problem of the sick. Their removal is one thing, and the accommodation at the other end is another. It is not pleasant to contemplate what such a move might mean in zero weather.

Still on the subject of vulnerability, but not of hospitals, we are deeply concerned with what is happening to the beauty spots of this Province. It is unlikely that we, in Ontario, are unique in our ability to ruin a view or ravage a shore. Our route to a summer cottage takes us past scores of lakes and small towns in Muskoka and to Parry Sound on the Georgian Bay. Of the towns, nothing can be said that could be in the slightest degree complimentary. Their function would seem to be to take the last dollar from the tourist, and give him nothing but merchandise, and, too often, indifferent food in return. Of beauty and order, there is no sign and posters invariably cover the highway approaches. We are particularly interested in one poster which identifies all the service clubs and their willingness to do anything in the public interest. What they could do, and what they have failed to do are just too painfully apparent.

Town planning advice and ordinary good taste, are required to eradicate the vulgarity of the villages and small towns. A greater problem, since it involves an educational process, is the spoliation of lake frontages. We have in mind particularly those lakes which the highway skirts, and those lost opportunities where a lake is partially hidden by posters, gas station and store. In some cases, the lake is completely hidden and the visitor has no knowledge of what he has missed, but, in many more, the lake in all its beauty is seen from a hill, only to be lost at the bottom behind a man-made mess of advertising and cheap building. The *Architectural Review* in England has more than once been quick to point out by article and illustrations where the English landscape has been disfigured by building, advertising or ignorant planning.

We should enjoy, in a morbid sort of way, photographing our own horrors, and drawing them to public attention, but the Film Board could do a far better job, and, from their files show, by contrast, those beauty spots still undefiled. They could also reach a far greater audience than this *Journal,* and we recommend such a project to them. It should have the support of all provincial governments, and certainly of the travelling public who care for order and decency and the beauty of forest, field and water.

STUDIO LOUIS PHILIPPE

"Hygeia" — a panel over the entrance to the Nurses' Home. Sculptor, Armand Filion.

The Montreal General Hospital — An Historical Note

THE MONTREAL GENERAL HOSPITAL was founded in 1821 on its present site; two smaller buildings downtown had preceded it in 1816 and 1819. In actual age, therefore, it is not by any means the oldest hospital in Canada, but its record in clinical teaching is easily the longest on the North American Continent.

When the charter of incorporation was applied for, the petition stated that the objects of the hospital were (a) treatment of the sick poor; (b) the perfection of medical science; and (c) the teaching of students. One member of the local Legislature objected strongly to the idea of allowing teaching in the hospital and fought a duel with Dr Caldwell, one of the hospital staff. Both men were wounded, but the charter was eventually granted.

The original staff of the hospital consisted of five men: J. Stephenson, William Robertson, A. F. Holmes, Wm. Caldwell and Henry P. Loedel. They were all Edinburgh graduates except Loedel, who was a Naval Surgeon; he died of typhus in the hospital in 1825. Stephenson was born in Canada, and Holmes came to the country at the age of four.

They meant what they said about teaching. As soon as the hospital opened they began to arrange for students and, in 1824, they opened the first Medical School in Canada, the Montreal Medical Institution, with twenty-five students. Their teaching was carried on partly at the hospital.

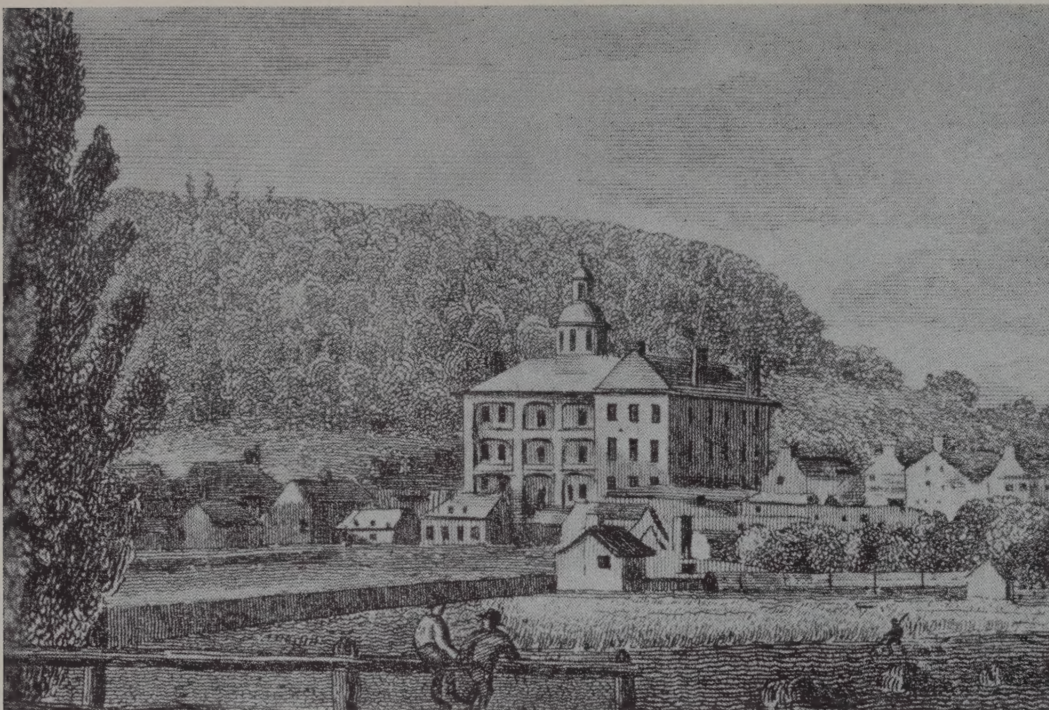
It was this School which agreed to form the Medical Faculty of McGill University in 1828. The University at that time had practically no students of any kind, and as it was required by the terms of the McGill bequest that teaching should begin before 1829, on penalty of losing the estate. The Montreal Medical Institution, with its ready-made course, came as a salvation. That was the beginning of the long and intimate association between the hospital and the University.

There has never been a year since 1824 that medical students have not attended the hospital. Its wealth of clinical material has always been outstanding. Osler comments on it: it was this and the clinical teaching which attracted him to McGill in 1870.

Apart from the teaching, or perhaps on account of it, the roll of names of those on the staff is long and highly distinguished. Osler, naturally, is pre-eminent, but he was both preceded, accompanied and followed by men who were of the highest type in their profession. R. P. Howard and his son, C. P. Howard; Sir Thomas Roddick, who first employed antisepsis in Montreal but whose real genius lay in medical politics; F. J. Shepherd, surgeon, dermatologist and anatomist; Wyatt Johnson who died young when his career showed brilliant promise; John McCrae, pathologist and clinician; these were all striking personalities. In later years, A. D. Blackader, H. A. Lafleur, F. J. Finley in medicine, and Geo. E. Armstrong and E. M. Eberts in surgery, were men of great distinction.

In both great wars in the last thirty years the hospital has played its part to the fullest extent.

The physical changes in the building since its foundation have been very great, but they have always been toward improvement, and as a teaching centre it has remained unexcelled.



The Montreal General Hospital prior to 1848

The Montreal General Hospital

McDougall, Smith & Fleming, Architects

THE MONTREAL GENERAL HOSPITAL is now situated between Cedar and Pine Avenues, just east of Cotes des Neiges Road, about half a mile from McGill University and practically in the centre of the English-speaking population on the Island of Montreal.

The land area comprises 385,000 square feet or about 8.85 acres with a difference in level between the two avenues of one hundred and twenty feet. The seeming difficulties presented by this condition were, however, turned to advantage by the evolution of an unusual plan which provides means of access to the buildings at many floor levels, not generally possible in developments of this type.

For example — by entering the property at the highest point on Pine Avenue, ramping up to the entrance there which is forty-five feet above street level, and by taking advantage of the space under the road-way, a well-lighted area comprising a sub-basement and basement was created, having a width of one hundred and fifteen feet.

The Pine Avenue Building, among other units, contains the out-patients' department, the McGill Dental School, general medicine treatment, Psychiatric Day Centre, psychiatric in-patients, and an amphitheatre seating two hundred and twenty-six.

The ambulance entrance is situated on the first floor at the rear of this wing and immediately adjacent to the emergency section of the surgical out-door department.

This entrance is arranged to accommodate two ambulances indoors with outside parking for five taxis, police cars or others which may be accompanying the patient.

Cases arriving by ambulance for admission to wards pass directly through the admitting department to the Cedar Avenue elevators and thence to their desired location.

En passant, it might be noted that all points within the hospital are accessible by the use of only one elevator.

Taking further advantage of the various levels, there is a basement service entrance with an indoor loading dock adjacent to storage areas, providing accommodation for four trucks. In the east courtyard behind this wing, at the third floor level, the morgue, which adjoins the autopsy and pathology departments, has an exclusive exit. Facilities for the disposal of garbage, not being incinerated, are also provided at this floor level.

The Cedar Avenue Wing, in addition to its accessibility from the lower floors, is more directly approached by a driveway separate from but parallel to the Avenue, with the main entrance ten feet below. This entrance is six floors above the one on Pine Avenue. All in-patients are accom-

modated in this Cedar Avenue Wing and the connecting link with the Pine Avenue Wing contains the ancillary services, ideally situated and common to both in and out-door patients.

Operating

The operating room suite is situated on the eighth floor and comprises eleven major rooms, one minor and a plaster room, making a total of thirteen.

Two operating rooms have viewing galleries with plate-glass screens and two others have a television booth between so that operations may be televised to student classrooms in other locations.

Major operating rooms have no outside windows and the entire area is fully air-conditioned.

Food Service

While opinions may vary as to the most efficient type of food service, it still remains one of the major problems in hospital design calling for highly functional, efficient performance.

In the present instance, all food is received at the Pine Avenue service entrance already described, where bulk storage, the necessary refrigeration and a preliminary vegetable preparation section are located.

Deliveries are made to the main kitchen on the fourth floor level via the Pine Avenue elevators. The food is served to the cafeteria and dining rooms at the north end or by means of elevators to the ward kitchen above, in electrically heated trucks for distribution to the wards.

Supplementing the elevator service, there are three electric push-button dumbwaiters serving directly to all ward kitchens.

X-Ray Department

This department, with its allied services, occupies the entire fifth floor.

Its situation permits the cobalt-therapy bomb being placed outside the building itself at Cedar Avenue which simplifies to a marked extent, the radiation problem.

The exhaust from radio-active isotopes will be carried outside the building to a height of ten feet above the twenty-second floor level.

The Laundry

This service is located in the basement with ample daylight and mechanical ventilation while the handling is largely automatic.

Pneumatic Tube System

The hospital enjoys the use of an automatic switching pneumatic tube system which provides a twenty-four hour service without special operators, facilitating the distribution of specimens and documents between the various groups.

Patients' Accommodation

Private Rooms	127
Semiprivate and Public	528
Obstetrics	43
Operating Recovery	11
O.P.D. Recovery	7
Total	716
Bassinets	51
Total — All types	767

Nurses' Home

The Nurses' Home is situated at the west end of the Hospital Buildings and is accessible from both Pine and Cedar Avenues. It houses two hundred and fifty-five nurses in single rooms together with the usual living rooms, including a school for under-graduates with class rooms and laboratories.

Interns

The interns are located at the opposite end of the Cedar Avenue Wing to the east, in an apartment house which was purchased and re-conditioned to meet the new requirements. Accommodation for approximately one hundred interns is provided.

Parking Facilities

In projects of this nature parking for automobiles inevitably arises and with the nature of the site in view this problem has been under continuous study.

At the moment provision has been made to accommodate three hundred and thirty-three cars or approximately one for every two bed patients which would appear to be a fair average. However, with the large out-door and dental clinic services contemplated, future developments in this direction are being carefully considered.

Nevertheless, if the costs were warranted and additional parking becomes necessary, two of the existing areas could be double-decked which would add space for about one hundred and thirty more cars.

With the high cost of bed accommodation in mind, architectural embellishment and clichés have, to a large extent, been avoided.

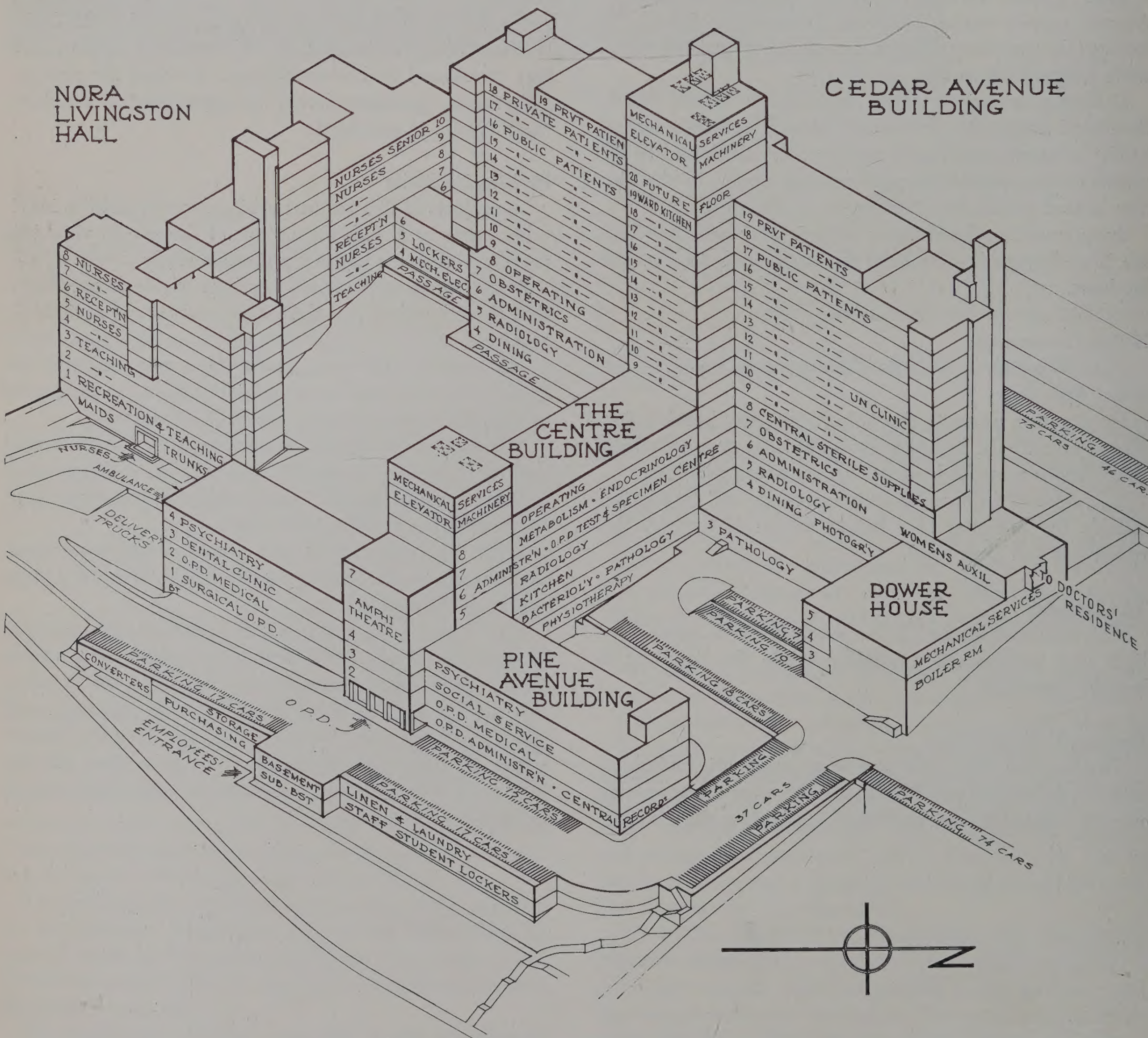
The Cedar Avenue side which is close to the roadway has a limited amount of stonework added but on the other elevations facing the city and seen from afar, the fenestration has been permitted to produce its own pattern amid the sea of brickwork. This rule also applies to the interior where the functions of the structure have been allowed to prevail, with a limited suggestion of applied adornment at certain focal points.

PHOTOGRAPHIC SURVEYS

Aerial view from east

PRINGLE & BOOTH LIMITED

View from south-west



Architects, McDougall, Smith & Fleming

Consultant, Dr Basil C. MacLean

Consulting Engineers, McDougall & Friedman
General Contractors, Anglin-Norcross Quebec Limited

The Hospital and Nurses' Home

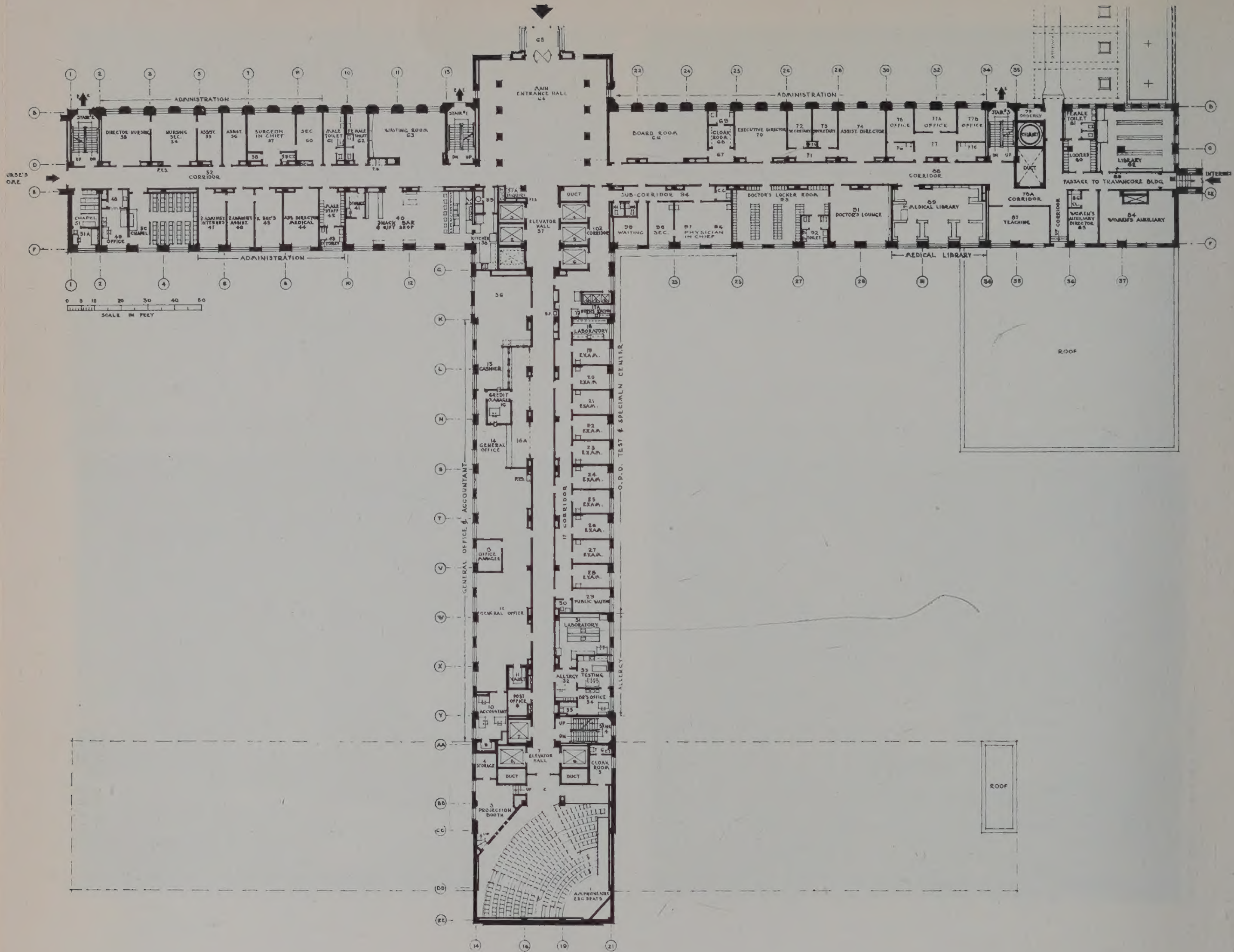
RAPID GRIP & BATTEN LIMITED

Nurses' Home from Cedar Avenue

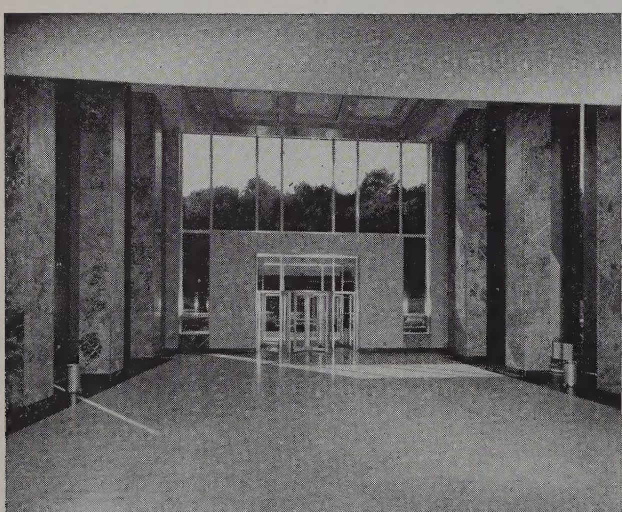
RAPID GRIP & BATTEN LIMITED

RAPID GRIP & BATTEN LIMITED

View from north-east on Cedar Avenue

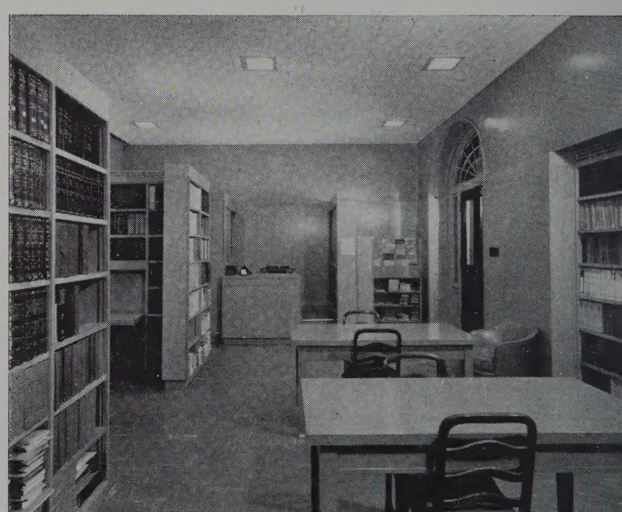


SIXTH FLOOR PLAN



RAPID GRIP & BATTEN LIMITED

Main entrance hall, Cedar Avenue



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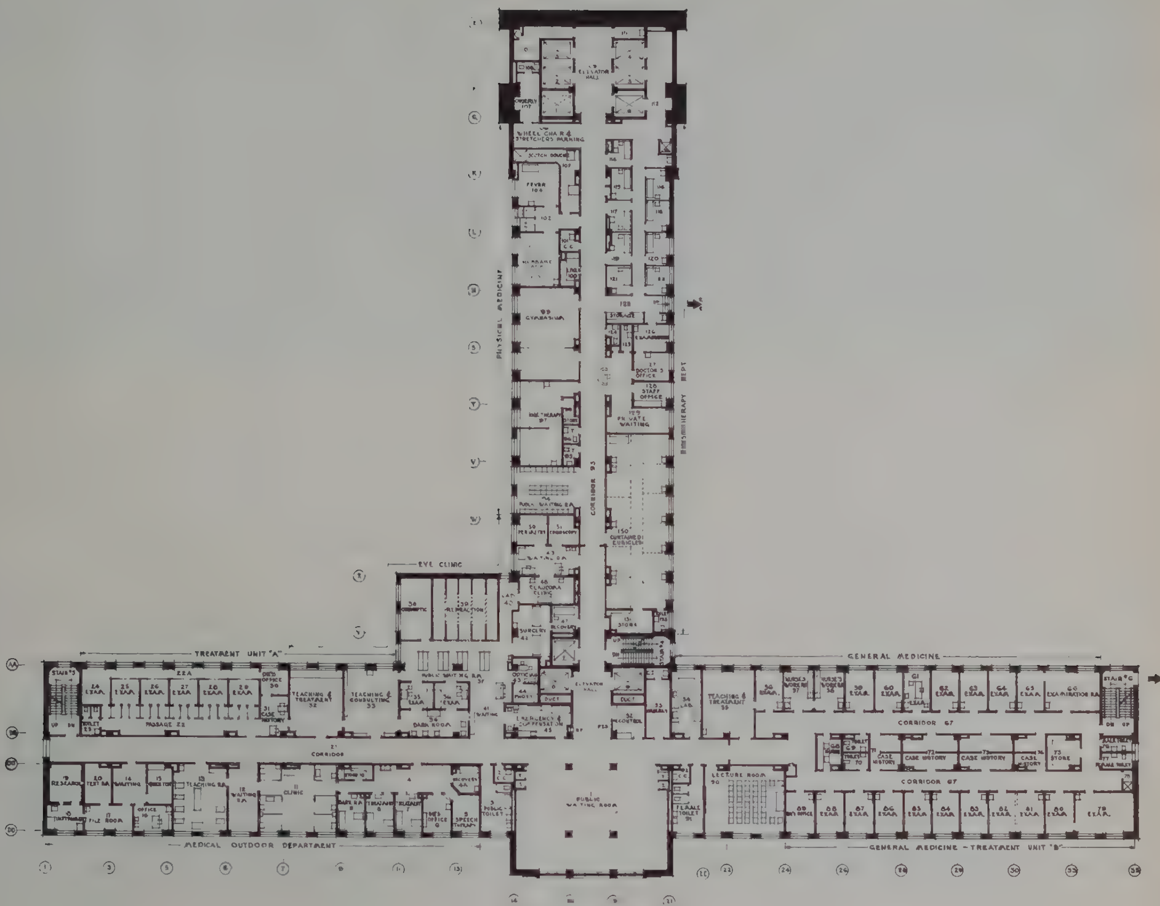
Medical library



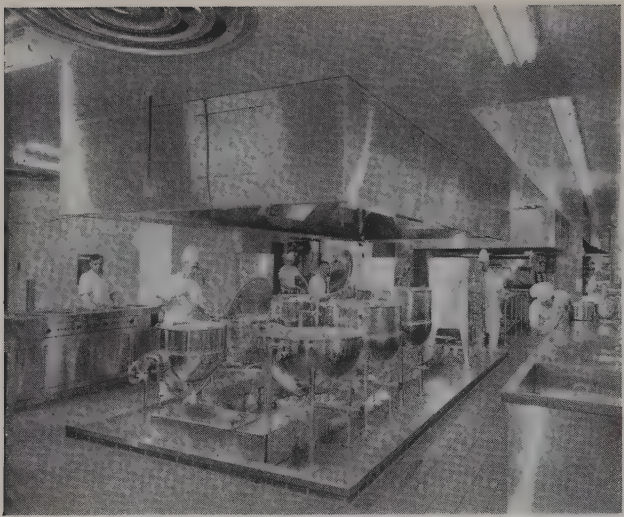
SECOND FLOOR PLAN

GRAPHIC ADS

Dental clinic

RAPID GRIP & BATTEN LIMITED

Entrance hall



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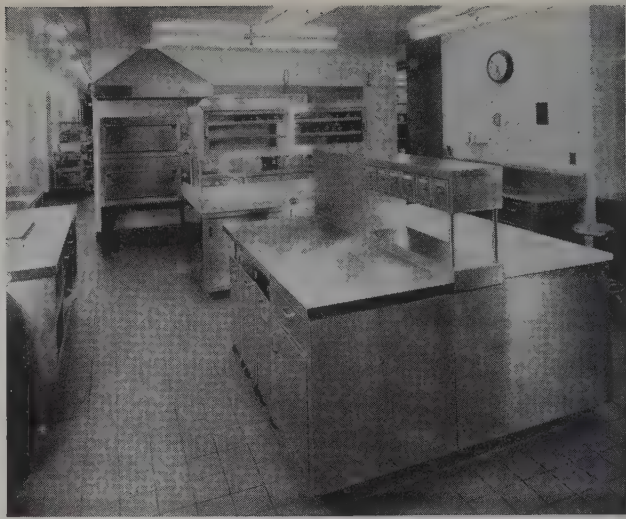
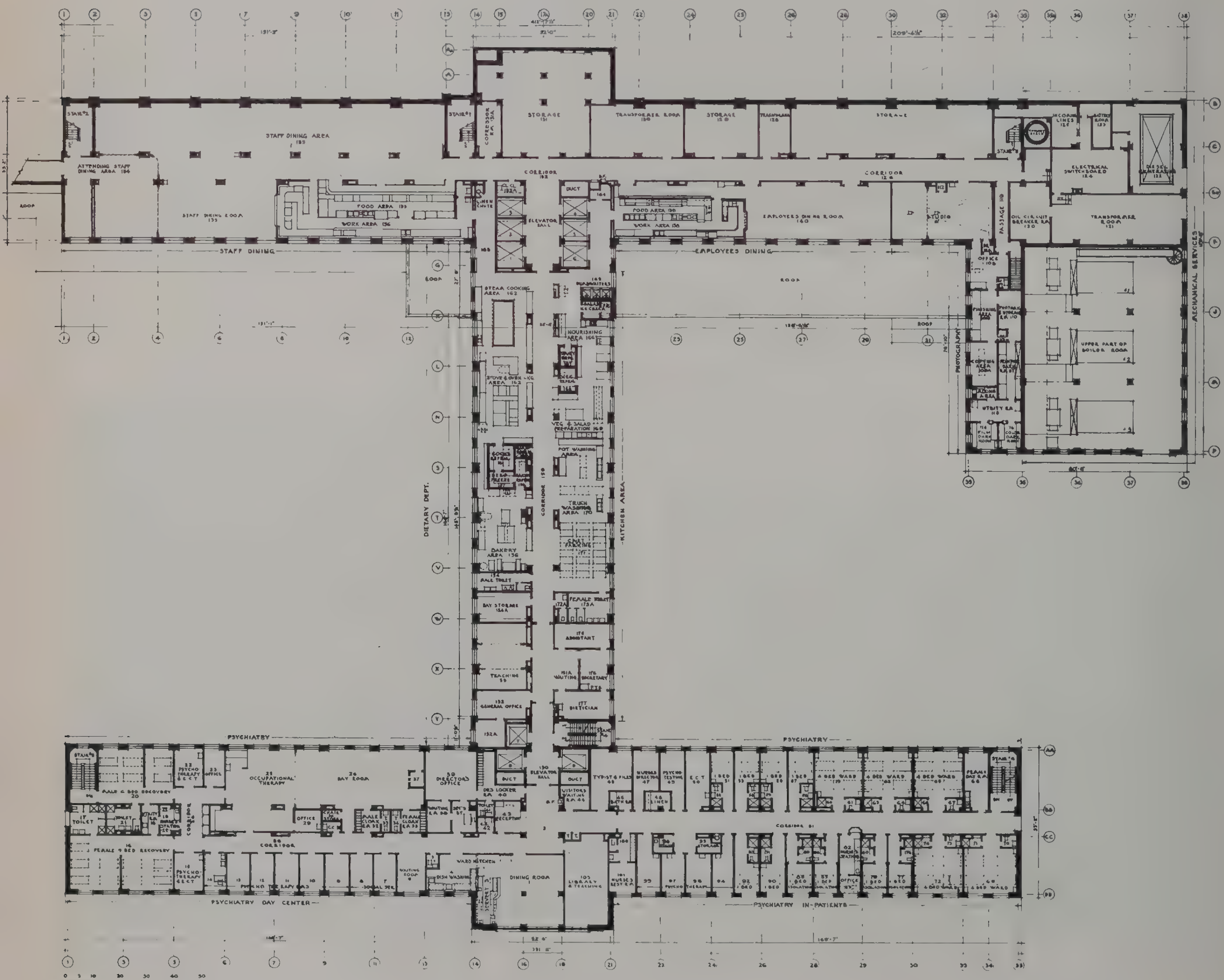
The kitchen



ARNOTT & ROGERS

The bake area



FOURTH FLOOR PLAN

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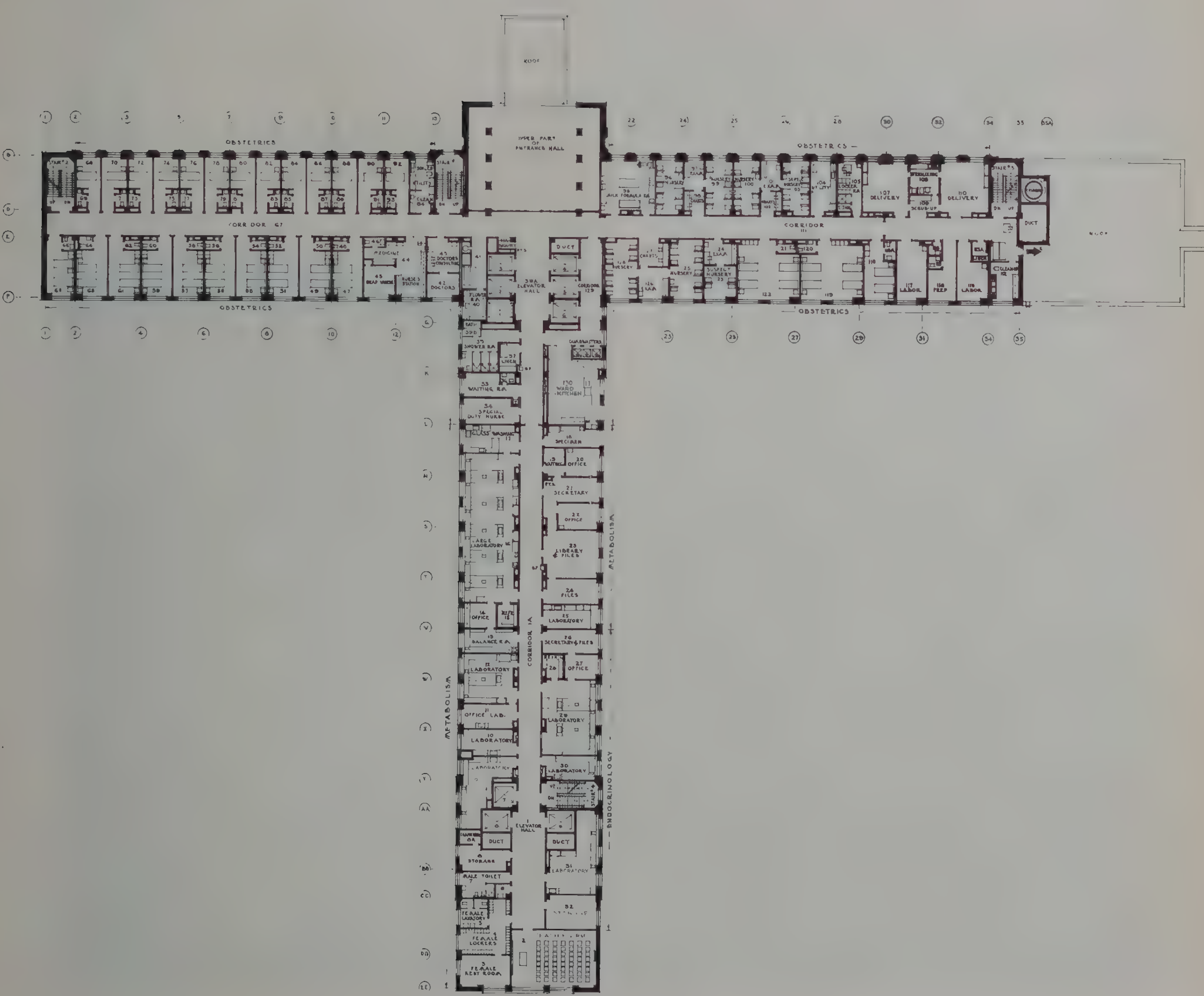
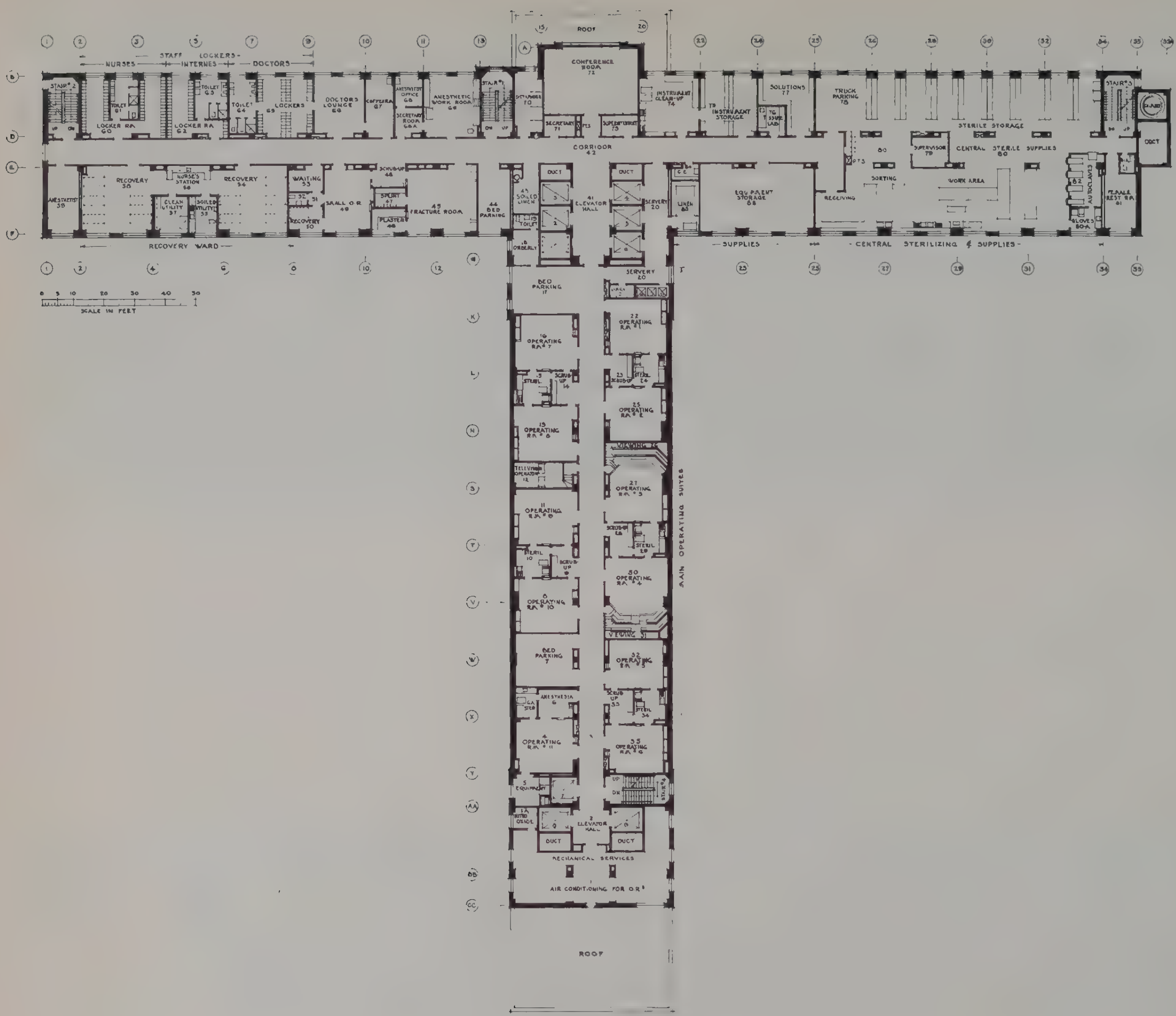
Ward kitchen

GRAPHIC ADS

Main metabolism laboratory

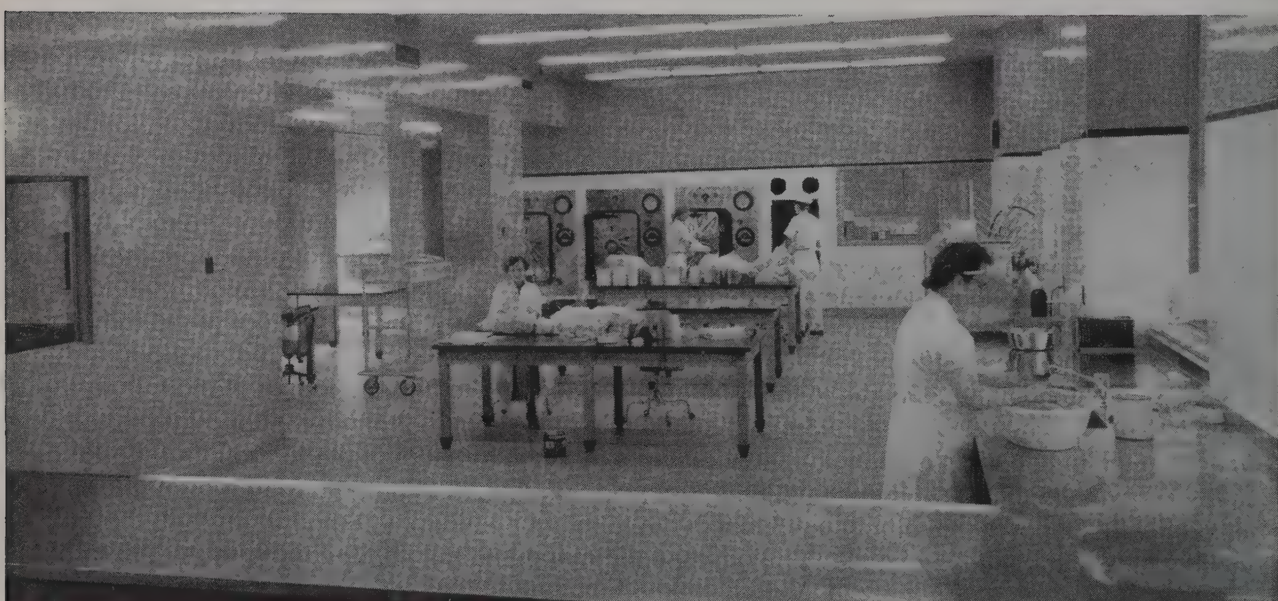


SEVENTH FLOOR PLAN

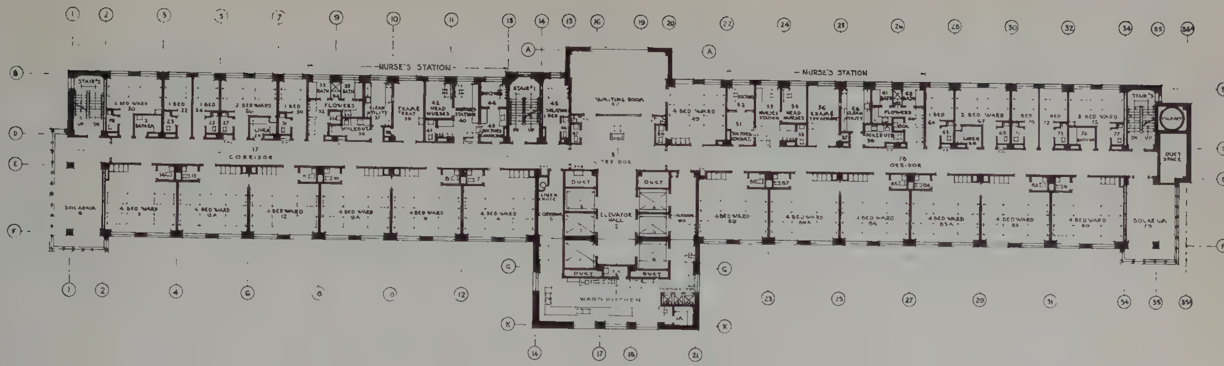


EIGHTH FLOOR PLAN

Central sterilizing

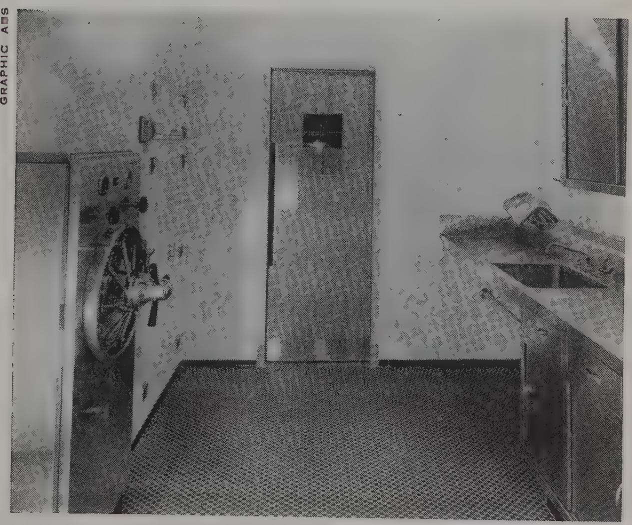


GRAPHIC ADS



TYPICAL WARD FLOOR
NINTH TO SIXTEENTH FLOOR PLANS

GRAPHIC ARTS



Sub-sterilizer room

Typical operating room

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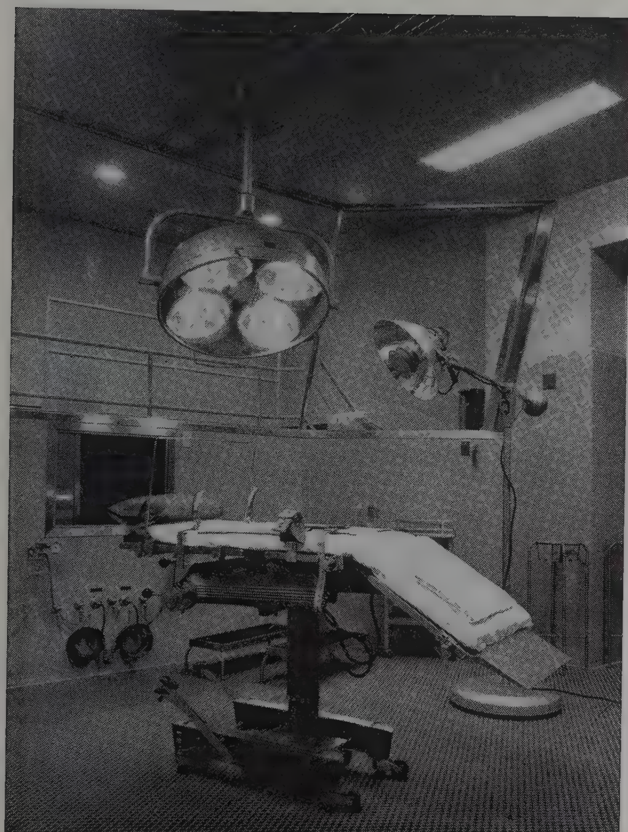

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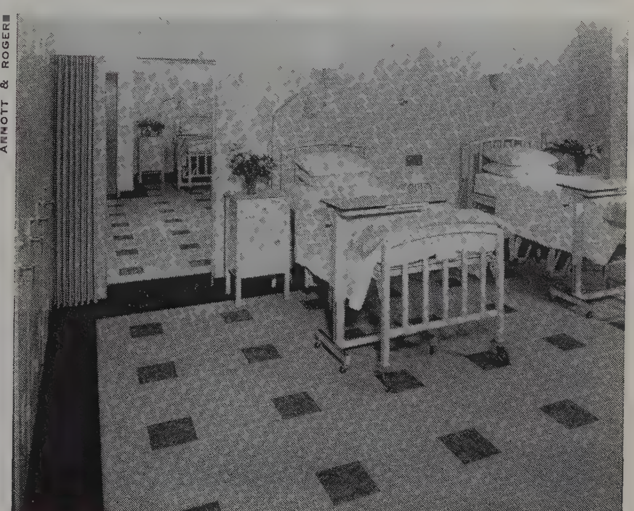


Typical four bed ward

The Medical Point of View

William Storrar

THE MONTREAL GENERAL HOSPITAL moved its new site at the end of May 1955 after a period of over one hundred and twenty-five years in the downtown eastern section of the city. One of the greatest teaching hospitals in North America, renowned throughout the world as the hospital where Sir William Osler introduced his bedside teaching of medicine, the Montreal General Hospital is one of the McGill University teaching hospitals. It is owned and operated by a Board of Governors – although it receives monies from municipal, provincial and federal authorities both for capital and maintenance expenditure, it is mainly dependent on public subscriptions. This hospital now completed cost nineteen million dollars to build and equip – approximately 75% of these monies came from public subscription and were raised as a result of two fund raising campaigns conducted in 1951 and 1953.

Built on a hill slope overlooking the city, the architect departed from the traditional stellate-shaped building which has been so popular in hospital building throughout the world in the last three decades. Using the grading of land most ingeniously, the architect has produced a hospital built on very simple lines and yet administratively very easy to operate.

When the decision to build this great institution on an entirely new site was made, the Board of Governors elected a small committee to deal with all matters, financial, constructural and administrative pertaining to the new building. This committee naturally had a very close liaison with both the architect and the engineer. In addition, the medical staff of the hospital were consulted on all aspects of the building and especially those areas where patient care was of paramount importance. This close liaison between the medical staff of a hospital in the course of the construction and the architect and engineer cannot be too strongly emphasized. The well-being and comfort of the patient – his clinical care as well as the economical functioning of the hospital must always be kept in the fore-front by all concerned during the period of a hospital's construction. Lack of liaison between the architect, engineer and the medical staff of a hospital may only result in a building where modern and good patient care is not possible. Those countries of the world where hospital construction is a governmental matter should not forget this close liaison between architect and medical staff – in some of these countries I have found that hospitals in the course of construction are often at the mercy of the dictates of the government employee be he architect, doctor or administrator and those who are going to operate the hospital and take care of the patient are forgotten. I would hasten to add that, in Canada, we are not in such an unfortunate position – government bodies, hospital staffs and hospital architects all work together with one common goal – the care of the patient.

The hospital is, broadly speaking, built in three sections – an out-patient section, an in-patient section with a third section running at a right angle connecting both the in-patient and out-patient sections and housing all the auxiliary services such as laboratories, operating rooms, kitchens, etc. With two main entrances, one in the out-patient section and one in the in-patient section, and with two banks of elevators in each of these sections, both the in-patient and the out-patient can easily reach the auxiliary services and with a resultant minimal cross-traffic.

I would now like to discuss in detail some of the features of this 750 bed teaching hospital which with its Nurses' Home and Doctors' Residence is probably one of the largest single piece of teaching hospital construction of this post-war era.

In-patient Wards

Apart from the three private in-patient floors which are housed on the top three floors of this nineteen storey building, all in-patient floors are similar in design. Each in-patient floor contains two nursing units and each nursing unit has approximately 32 beds in 4 bed, 2 bed and single bed rooms. To facilitate the nursing of patients, the 4 bed rooms connect one with another by a short modernfold door. Oxygen and suction outlets are available for each bed. The oxygen is piped from a large liquid oxygen cylinder situated in the grounds of the hospital. The suction outlet is situated 21″ from the floor – to facilitate the attachment of the modern monometer type single suction bottle. A nurse patient call system outlet is also situated between each bed. This equipment has been installed to ease the nursing services and allows the patient to talk to the nurse and thereby save many "nurses-steps". A pillow radio and individual built-in lockers are two other features of the patient wards. Each locker is equipped with a strong box for the depositing of valuables. At the end of each nursing unit there is a large solarium for the use of convalescent patients. With early ambulation now a recognized feature of modern treatment, especially in surgical cases, a patient solarium is essential in any modern hospital. The nursing station is designed on standard lines with clean and soiled utility rooms. A "pass through" from the clean utility room to a treatment room again is designed to save nursing time. The treatment room is equipped not only to take a bed but also has an examination couch – to care for change of dressings, injections, etc., for the ambulant patient. The linen room has sufficient floor space to house the laundry truck which comes up daily from the laundry in the basement. Another "pass through" has been placed between the nurses' station and the small clinical laboratory. This space takes the mobile chart rack which accompanies the doctor when he makes his ward rounds and when in place allows the doctor and the nurse to view the chart easily. A small clinical laboratory is an essential feature of a nursing unit. This laboratory is designed to deal with examinations of bloods, urines, etc. Adjoining the laboratory is a small doctors' office for the review of case histories and minor conferences.

Serving each floor and common to the two nursing units are a waiting room, a ward kitchen and an area for the floor clerk. The waiting room is so designed that during the mornings it is used for bedside teaching to under the post-graduates. The floor clerk's desk is so situated that the floor clerk receives both visitors and patients as they reach the floor, and by telephone link the floor clerk can intercept and answer many of the in-

quiries directed at the nursing unit.

The Dietary Department

This department is organized on traditional lines with a central kitchen serving as a cooking area for all food in the hospital — both patients and staff. The cooked food is transported by heated electric trucks to the patient floors. The ward kitchens are used for the preparation of coffee, tea, toast and the storage of juices and milk. The dishes are also stored and washed and the trays prepared in the ward kitchen although the hot food is served from the heated trolley in the patients' ward. The initial capital outlay of this type of ward kitchen is high especially when equipped with refrigerator, ice-making machine, coffee-maker, milk dispenser, dish-washing machine, toaster, etc., — however, too often today in building modern hospitals is the dietary department overlooked and too often are modern industrial feeding methods resorted to. I believe that modern industrial feeding methods cannot be adopted in hospitals. Furthermore, it is of paramount importance that attractive, palatable, well-cooked hot food be available for all patients. How often do we hear the words "institutional type food"? — this type of food should never exist in the modern hospital but careful planning of kitchen and methods of serving food are essential.

Surgical Operating Rooms

Altogether twelve theatres are available on the eighth floor. These theatres have been built in pairs with a scrub-up room and sub-sterilising room between each theatre and serving each pair. The theatres are air-conditioned and windowless and are equipped with powerful operating lights which by means of a small sterile handle can easily be manipulated by the surgeon during an operation. In addition to oxygen and suction nitrous oxide has been piped to each theatre. Two of the theatres are equipped with viewing galleries useful for medical meetings but not essential for the teaching of medical students. Adjacent to the theatres are the recovery rooms. After operation the patient is taken to the recovery room where he remains till recovered from the anaesthetic and in a fit condition to return to the ward. By this means the anaesthetised and acutely ill patient can be more expertly nursed and is always under constant supervision. Also on the operating theatre floor is the central sterile supply room. This occupies a space of 4000 square feet. Here all the dressings, instruments and materials, with the exception of operating room instruments, are cleaned, packed, sterilised, stored and distributed to the whole hospital. For example, all syringes and needles for the hospital are prepared and issued. Although the initial capital outlet in setting up a central sterile supply room is high — the maintenance is very low and, at the same time, a very high standard of sterilising technique is obtained.

Laboratories

The laboratories are situated in the connecting wing. The main biochemical laboratory is on the seventh floor. The rooms have been built on traditional lines. Patients do not visit these laboratories. Specimens are taken from in-patients by technicians visiting the wards while out-patients attend the test centre on the sixth floor. This test centre is a series of small examining rooms where a battery of tests can be carried out on the ambulant patients quickly and with a minimum of inconvenience.

The pathology and bacteriology laboratories are on the third floor and are equipped with suitable cold storage areas for vaccines and animal houses. Sufficient space has also been given for the storage of microscopes and microscopic specimens — essential in a teaching hospital. The morgue area has its own exit door in a secluded part of the parking area.

Radiology Department

This department is situated on the fifth floor and occupies the whole floor having attached to it but not under its control the cystoscopic rooms, cardio-respiratory centre and the electroencephalography department — departments which frequently require the use of radiological equipment. The rooms are equipped with machines which will cover the full range of radiodiagnostic and radiotherapy techniques including a cobalt 60 unit. The fluoroscopic rooms are air-conditioned for the comfort of the patient and the radiologist.

Obstetrical Unit

This unit is situated in the in-patient wing on the seventh floor with 43 beds and 50 bassinets, 2 delivery rooms and 4 labour beds. The nursery which is cubicilised is air-conditioned, one section being set aside as a premature nursery, another section as an isolation unit.

Psychiatric Unit

The entire fourth floor has been set aside for psychiatric patients, both in-patients, out-patients and Day/Night Centre patients. It is equipped with a large occupational therapy unit — so much a part of modern psychiatric therapy.

The Out-patient Department

This department occupies two floors with a surgical O.P.D. and casualty department on the first floor and a medical O.P.D. and specialty clinics on the second floor. The casualty department is separated from the surgical O.P.D. and is maintained on a full twenty-four hour basis. It is within easy access of the ambulance entrance. All emergency rooms are equipped with oxygen and suction and alongside these rooms are two emergency theatres for minor and emergency surgical procedures.

These briefly are some of the features of this new building, constructed in the short space of three and one half years and born of the cooperative effort of architects, engineers, Board of Governors and Medical and Administrative Staff — an edifice worthy for the teaching of medicine and healing of the sick for many years to come.

McDougall & Friedman, Consulting Engineers

Boiler Plant

The boiler plant is located in a separate building connected to the third, fourth and fifth floors of the Cedar Avenue Building.

High pressure steam originates in three water tube boilers and is distributed to the various buildings of the group, and, after the pressure is reduced, supplies steam to hot water heating convertors, domestic hot water tanks, kitchen and laundry equipment, sterilizers, ventilating systems, etc., and boiler plant equipment requiring steam. All condensate from the above equipment is returned to the boilers.

Heavy oil is used as fuel and is fed to boilers by means of steam-atomizing oil burners, from three twenty thousand U.S. gallon tanks located under Cedar Avenue roadway. There is also a five thousand gallon light oil tank that is used for starting purposes and also to fire the incinerator.

The boilers are arranged so that spreader stokers can be installed should it ever be necessary to use coal as fuel. Allowance is also made in the concrete work for the future installation of ash conveyors and the storage of coal.

Two boilers can carry the load and one acts as a spare. Each boiler has a capacity of 30,000 lbs. of steam per hour for continuous operation, which is approximately equivalent to 870 boiler horse power. The rough rule of thumb method of so many boiler horse power per bed should not be used in comparing the installed boiler horse power with that of another hospital. Owing to the fact that less than 20% of the total square foot floor area of the hospital (not including Nurses' Home) is patients' bed room floor area and the fact that there is a large ventilating load requiring steam for heating the air, it would be dangerous to use that method of comparison.

Heating Systems

The buildings are heated by hot water with forced circulation. Convertors for heating the water and circulating pumps are located in "machinery" rooms in the various buildings.

Steam for the convertors is supplied from the boiler plant at 125 p.s.i. and reduced to 5 p.s.i. at the convertors. Condensation is returned to the boiler plant from the convertors by means of condensate return pumps.

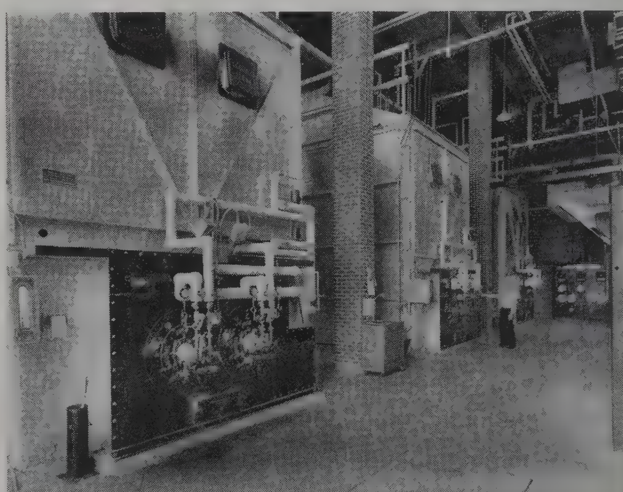
All rooms are heated by means of convector radiators with steel cabinets, except certain areas have unit heaters. Convector radiators are "custom" built according to engineer's design. All window stools are of aluminum and are part of the convector radiators. The lower part of the convector, which contains the return grill, is hinged so that the heating element can be easily cleaned. Most of the convectors are concealed except in a few areas where there are no windows.

Each convector has two valves, one on the supply which is either a hand operated valve or a diaphragm valve (thermostatically controlled) and a lockshield valve on the return to regulate the flow. With these two valves, a convector can be removed without affecting the rest of the system.

All air conditioned areas, all patients' rooms, and rooms that have variable occupancy such as waiting rooms, laboratories, etc., are thermostatically controlled by means of diaphragm valves on radiators and thermostats in the rooms. In the Cedar Avenue Building patients' wards, it was determined that individual room control was not any more expensive than zone control, which is necessary for a building of its height and exposure. The cost of the controls was more than offset by the cost of the extra piping, extra convertors and pumps, etc., and the space saved. Besides, individual room control is more satisfactory and has more economy of fuel than a zoning system.

The hot water temperature in each building is control-

Boiler room



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led separately by means of an outdoor-indoor temperature regulation system controlling a three-way mixing valve. The convertors are not controlled and are kept at a temperature of 215° constantly with 5 p.s.i. steam pressure. The temperature in the various systems are varied by means of the three-way valves which reduce the temperature if required by means of the return water.

Expansion of all mains and rising lines where required are taken care of by means of expansion loops. No expansion joints are used. There is a separate expansion tank of the "open" type for each separate heating system.

Plumbing

The cold water supply is divided into a high level system which takes care of all floors above the eighth floor and a low level system which takes care of all floors below the eighth. The high level system is fed from a steel tank located in Cedar Avenue pent house. The low level system is fed direct from the city mains. The tank in pent house has a capacity of 15,000 gallons, 5,000 gallons of this (lower portion) being used for fire protection.

In order to keep the pent house tank down in size, and for protection against city water failure, a concrete reservoir of 10,000 gallon capacity was installed under the ground floor of boiler house. Water is pumped from this reservoir direct to the fixtures on the high level system or to the pent house tank if it needs water. If, for any reason, the pumps are stopped, the pent house tank will feed the high level system for a period depending on requirements at the time.

The cold water system was designed for an approximate peak usage of 1,000 gallons per minute. There are three 500 gallon per minute pumps to handle the cold water. Two pumps are steam driven and one which is a spare is motor driven. The two steam driven pumps are entirely automatic and the second one comes into use or stops depending on the demand. The motor driven pump is manually operated and is only used when the steam pumps are out of commission. The cold water piping is laid out and valved so that the reservoir in boiler house (and therefore all the buildings) can receive water from either the Pine Avenue or Cedar Avenue city main.

There is a City of Montreal plumbing by-law which forbids the installation of any plumbing fixtures etc. which might provide a cross-connection between the city water distributing system and any plumbing system or make possible the back flow of sewage into the water supply. This would include any fixture where a rubber tube or hose is liable to be connected to a tap, bed pan cleaning jets with hose and hand operated supply valves, etc. The department in Montreal are very strict in connection with this by-law in order to avoid possible cases of infection, especially in hospitals, where the cause might be due to back flow, after a cold water line had been turned off and then put on the line again. The department banned the use of vacuum breakers, except in special cases, as they found that in quite a few cases the breakers were taped up or removed. It was therefore necessary to run separate cold water lines from tank in pent house to all laboratory sinks etc. Allowance was given to use vacuum breakers in connection with the bed pan cleansing jets as they are all foot operated and close as soon as the foot is removed.

There are eight domestic hot water storage heaters located in the various buildings. There is a complete forced hot water circulating system to insure hot water at a fixture in a short while after a tap is opened.

There are approximately 1,841 plumbing fixtures of various types. This includes laboratory sinks etc., but does not include kitchen or ward kitchen sinks. The plumbing fixtures consist of standard type fixtures such as lavatories, water closets, etc., special hospital type fixtures such as all service sinks, plaster sinks, clinical sinks, medicine sinks, etc., and stainless steel sinks. Most of the sinks other than those described above are of stainless steel and are either separate counter top sinks or are integral with a counter top and set over a wooden cabinet.

All lavatories in patients' rooms and toilets, consulting and examining rooms and where used by doctors and hospital type fixtures, have arm action blade handles. All lavatories have backs but do not have lift waste or plug and chain. Drinking fountains are self-contained electrically operated.

Surgeon wash-up sinks located between operating rooms are stainless steel troughs completely enclosed on front and exposed side, with an access door for access to traps etc.

All water closets in patients' toilets, and where they are near patients' rooms, are one piece quiet action tank combinations. Water closets in patients' toilets and where bedpans are used, are equipped with bedpan lugs and pedal operated bedpan cleanser.

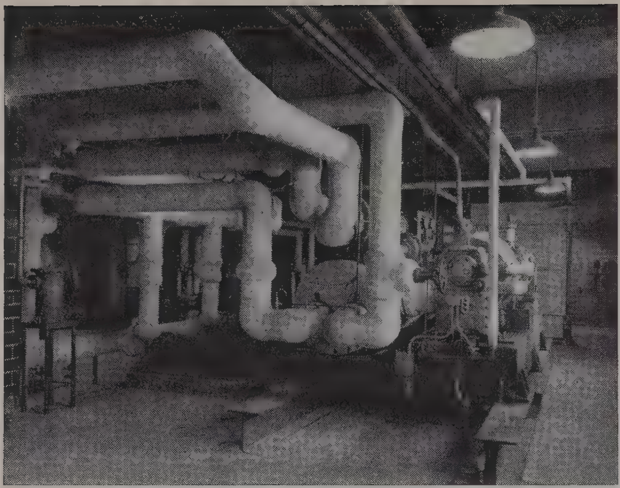
There are two autopsy tables located in autopsy room. These tables are specially designed and made of stainless steel.

There is one tank and wading trough of Hubbard design located in physical medicine department. The shape of the tank is a modified figure "8". It permits the physical therapist to reach the patient on either side without entering the tank. Two electric turbine ejectors and aerators are mounted on the tank and produce an underwater thermal stream which can be actuated directly upon the affected parts of the body. A wading trough is part of the tank. The trough has adjustable hand rails and steps. A cover is placed over the trough when the tank is used for full body immersion treatment. The tank is complete with thermostatic water mixing valve and thermometer assembly mounted in a steel cabinet, hoist and trolley suspended from an I beam etc.

A stationary vacuum cleaning system is installed to take care of the patients' floors. Due to the fact that with a stationary vacuum system all the dust is brought to a central point, it was felt that there was less chance for contamination than there would be with individual vacuum sweepers with their dust bags etc. There are about 102 inlet valves located in the corridors of the various floors connected by piping to a central unit, located in garbage room on third floor (near boiler house).

Ventilation and Air Conditioning

When the term "air conditioning" is used it means summer cooling and winter ventilating and humidification. When the term "ventilation" is used it means all year



Air conditioning refrigerator compressors

round exhaust of air only or exhaust and supply of air and no summer cooling. All air supplied in the winter is heated and humidified.

Where there is a preponderance of exhausted air in certain areas, supply air is introduced in the corridors or other rooms in order to balance conditions and prevent drafts. There is a total of 15 supply and 28 exhaust fans in connection with the ventilating and air conditioning systems.

Where hazardous gases are used such as operating rooms, anaesthesia room, delivery rooms, fracture rooms, cystoscopic rooms, plaster rooms, etc., the rooms are ventilated in accordance with regulations as recommended by the National Fire Protection Association. No air is recirculated from rooms where hazardous gases are used.

All patients' toilets which are a part of each patient room have exhaust ventilation. This also helps to ventilate the rooms. In order to prevent cross contamination, air is supplied to the corridors to keep them under a positive pressure (as well as supplying make up air).

In general, the types of rooms that are ventilated are all rooms which do not have outside windows and are used by hospital personnel, patients and others; all toilets with windows having three or more water closets; all rooms in which there are liable to be odours, such as laboratories, autopsy room, morgue, animal rooms, utility rooms, clean-up rooms, locker room, etc; all spaces where moisture, steam and excess heat are generated such as cooking spaces, dish washing and serving areas, laundry, etc; all rooms where hazardous gases are used; certain rooms (with windows) where a number of people congregate such as lecture rooms, public waiting rooms, dining rooms, etc.

The spaces that are completely air conditioned are the entire operating suite, including the recovery rooms; the delivery, labour and preparation rooms and the nurseries and examination rooms in obstetrical department; the board room and executive director's room; certain bed rooms on ninth to nineteenth floors for allergy patients; four fluoroscopic rooms; the photography department.

An 180 ton refrigeration unit located on fifth floor of boiler house furnishes cold water for the cooling coils in the various air conditioning units. A cooling tower to cool the condenser water is located on the roof of the boiler house.

Separate ducts are run to each operating room, delivery room and labour rooms from their supply fans. Each separate duct has a reheater installed in it, connected to a thermostat in each room, so that each room can control its own temperature.

In general, acoustic insulation is installed inside of ducts near supply and exhaust fans, where required to reduce decibel ratings. The inside of all runouts to grilles and registers and all elbows in connections with the operating rooms, delivery rooms and nurseries have a coat of sound absorbing paint.

Sterilizing Equipment

All the instrument and utensil sterilizers in utility rooms etc., are pressure steam sterilizers with the exception of the portable electric instrument sterilizers and two others (cystoscopy and eye clinic) which are of the boiling type. The present trend is to use pressure sterilizers wherever possible to obtain better sterilization.

Bedpans are emptied in the water closets in each patients' ward and sterilized in the pressure sterilizer in soiled utility rooms. Each patient has his own bedpan which is sterilized after he leaves. Utensils etc., used on the floors are also sterilized in this pressure sterilizer. Most of the sterilization for dressings etc., is taken care of in the central sterilizing room on the operating suite floor.

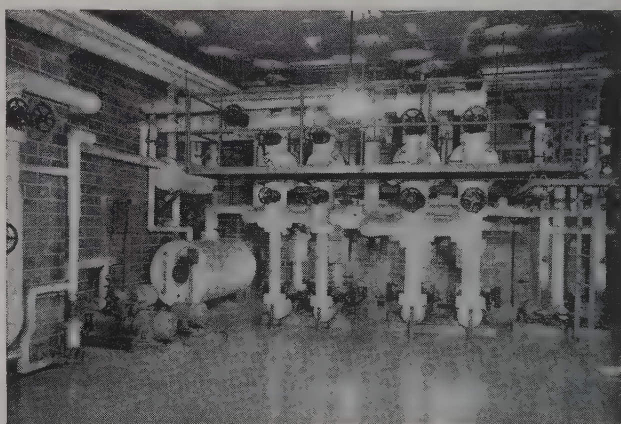
All water is sterilized in flasks in the central sterilizing room. The water for use in the operating rooms is kept in flask warming cabinets in sub-sterilizing rooms located between each two operating rooms. Distilled water is used so that a lime deposit will not be made in the flasks.

The central sterilizing room contains three rectangular pressure sterilizers, one cylindrical pressure sterilizer and one dry air sterilizer all recessed in one enclosure. The room also contains two water stills. There is also a glove room adjacent containing a glove conditioner and an automatic washer.

The formula room on obstetrical department contains a milk formula pressure sterilizer and an electrically heated mobile bottle warmer.

Each sub-sterilizing room on seventh and eighth floors has an exposed 16″ x 24″ emergency and hi-speed pres-

Typical convertor room



sure instrument sterilizer of the cabinet type with a stainless steel housing. Each of these rooms also has a 30 gallon recessed mounted flask warmer, steam heated.

The instrument clean-up room on eighth floor contains two pressure instrument washer sterilizers. Although they are primarily used for washing instruments in bulk they can be used in an emergency as a high speed sterilizer. Besides time and labour saving, and advantage of these units is that the nurse does not have to touch each instrument individually with the possibility of injury or contamination. The complete cycle of washing, sterilizing and drying is controlled automatically.

Besides the above mentioned sterilizer there are also sterilizers of various types located in laboratories, outpatient department, emergency department, pharmacy department etc.

Oxygen Supply and Vacuum Wound Drainage

Oxygen supply is delivered to the patients by means of an oxygen piping system which receives its supply from a specially designed insulated spherical tank containing liquid oxygen, and located on the grounds. The unit is provided with vapourizing and pressure-regulating equipment which operates automatically. The liquid oxygen is converted to gaseous oxygen and supplied to the pipe lines at a predetermined pressure as it is required. The pressure carried is lower than that of any other type of oxygen system.

The liquid oxygen is delivered to the unit in mobile trucks especially designed for this type of service. The storage unit includes a bank of emergency reserve cylinders containing gaseous oxygen, which will automatically supply the pipe line with oxygen should there be a failure in the primary supply. There is no interruption of oxygen flow to the piping system when the unit is being refilled and there is no change in line pressure when the unit goes over automatically to emergency reserve supply. When a patient is to receive oxygen, the nurse has merely to attach a flowmeter to the wall outlet, connect the administering apparatus, and turn a valve to start the flow of oxygen.

All oxygen service outlets are Schraeder Oxygen Coupler Check Units with dust cap assembly to accommodate only Schraeder "Safety-Keyed" oxygen adapters. There is one outlet for each single bed in patient's room, one outlet for each two beds in two and four bed rooms, and one outlet for each bed in recovery room, and one outlet in each anaesthesia room and two outlets for each operating room etc.

Vacuum outlets for wound drainage are located in patients' rooms, one outlet for each single bed and one outlet for each two beds between the beds; one outlet for each bed in recovery rooms; one outlet in each of the anaesthesia rooms and two outlets in each operating room etc. All vacuum outlets are connected by means of piping to a vacuum pump unit located in machinery room in Pine Avenue Building.

Electrical

Electricity plays such a vital part in the operation of the modern hospital that the system must be designed to provide not only adequacy but also the utmost reliability. Electricity is essential in whole or in part not only for lighting but for heating, vertical transportation, preparation of food, ventilation, refrigeration, fire protection, signal and communication, treatment apparatus, etc., without which the hospital cannot function.

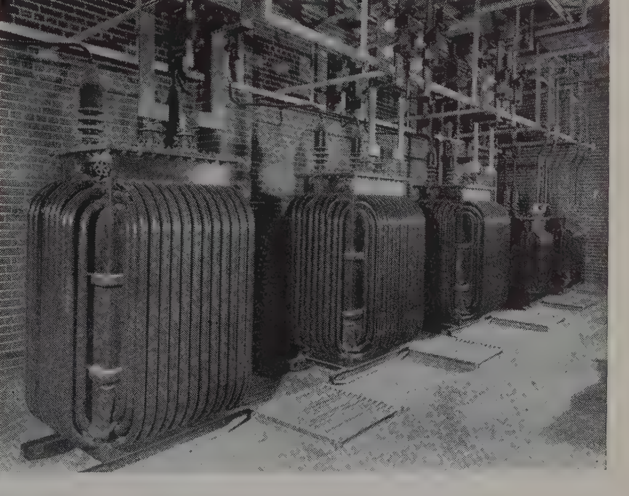
Electric power is supplied by Hydro-Quebec at 12,000 volt 3 phase 60 cycle via two underground cables. Each cable is fed from separate source to insure least possible probability of both sources failing at the same time. Each line terminates at the hospital in an electrically operated oil circuit breaker complete with automatic devices for protection and to switch automatically over from a dead line to a live line in case of one line failing for any reason.

A main transformer station located indoors near the boiler house transforms from 12,000v to 575v, 3 phase and all distribution beyond this main transformer station is at 575v. Motors and other power load are fed directly from the 575v system while lighting and other similar loads are supplied via 575/120-208v transformer banks located throughout the building. These latter transformers are dry type and hence do not require special vaulting as would be the case with high voltage or oil filled types.

The distribution equipment for all main power and lighting is via factory made low reactance type bus.

To take care of complete failure of outside power two additional sources are available. To take care of such locations as operating rooms etc., where even a momentary failure is at least inconvenient, if not hazardous, the main station battery comes into operation to provide the small but high priority requirements. This is limited to operating

Transformer room



GRAPHIC ADS

rooms, partial stair lighting, boiler room, electric station, etc. To take care of the larger requirements, but not complete service, a diesel driven electric generator is provided which will restore more complete lighting, will permit operation of heating plant, essential ventilation requirements and one elevator.

Fluorescent lighting is used extensively but not exclusively. The higher efficiency of fluorescent lighting together with the better colour of modern fluorescent lamps makes their use possible and advantageous. Lamp auxiliaries have been selected to keep servicing requirements to a minimum.

Local switches in all locations are of the new silver contact quiet type.

Electrical work in all operating suites has been treated in accordance with rules and recommendations of Canadian Electrical Code and National Board of Fire Underwriters. Floors are conductive, electrical circuits are isolated and ventilation is arranged to keep hazardous area below the five foot level. In the hazardous areas all fittings and devices are of the approved explosion proof type. Failure of air supply or accidental grounding of any circuits is immediately indicated by warning lights.

Power for permanently installed X-ray equipment is provided by a separate transformer bank and low reactance type bus to maintain uniform voltage with minimum of fluctuation.

All receptacles throughout are of the three wire grounding type which permit any plug-in device to be automatically grounded and at the same time will accommodate standard two wire plugs.

Nurses' call system is of the audible and visual signal type with voice communication between patient and nurses' station. For reliability reasons the voice communication system is independent of the audible and visual although they work together. Provision is included to transfer calls from one nurses' station to another in the case where a station may not be continuously occupied. The nurse call system is fed from both the normal and the emergency electric source.

Telephone service is provided in all offices etc., and is available in certain wards. To provide telephone service for balance of wards a "tele-cart" system is provided whereby a portable pay station with trailing cord is taken from ward to ward at certain hours. Some entirely self-contained local systems are provided for special services such as ward kitchen to main kitchen, admitting office to records department, etc., but in general all internal communication is handled on the public phone system through a local dial type exchange.

Three doctors' in-and-out boards are provided; one at each of two entrances and one at telephone switchboard room. On entering the hospital (at either entrance) the doctor operates the switch opposite his name. This causes his name to be illuminated on all three boards. If a message is awaiting him his name will flash off and on rather than burn steadily indicating to him that a call is waiting. The control of the flashing feature is by the telephone switchboard operator. On leaving the hospital (at either entrance), operation of the switch extinguishes the light at all three boards.

Similar but smaller scale systems are used in such departments as dental clinic to visually convey information as to waiting patients etc.

Paging throughout the building for doctors, internes, etc., is by voice communication over a public address system operated from the telephone switchboard room. Speaker locations have been selected where paging calls will most likely be received and where patients will not be disturbed by repeated calls. Answering of paging calls is by telephone directly to the paging operator where the message is given and the paging call cancelled.

Radio for patients' entertainment is provided to all beds. A central receiver with five channels is provided and each channel is wired to a bed side, wall-mounted selector switch and an under pillow speaker. Change of station and off and on is controlled by merely pulling the speaker cord. The use of pillow speakers allows each patient to select the program he wants without disturbance to or interference with other patients.

A fire alarm system is provided throughout the hospital proper and tied in with those of the Nurses' Residence and the Internes' Residence. Automatic detectors are provided in storage and other areas which may be unoccupied or unsupervised over part or all of the day or night. Manually operated stations are provided on all floors. The "pulling of a box" either automatically or manually sounds a code which indicates the floor and the general location on the floor thus identifying the location. The signal is first transmitted to a limited number of people who have definite duties in case of fire. If the situation requires more assistance a second alarm is rung in and this alarm covers a greater area. In no case are alarms audible to wards as such would cause unnecessary concern to people who in most cases are not in a position to help themselves.

For instructional use provision has been made to televise certain operating rooms and transmit to areas where students or other groups may observe.

Electric devices are used extensively in the preparation and distribution of food.

Church of St. Jean Gualbert, Laval-sur-le-Lac, Quebec

Architect, Claude Longpré
(now of Longpré & Marchand)
Associate Architects, Crevier, Lemieux & Mercier

General Contractor, Benjamin Robidas

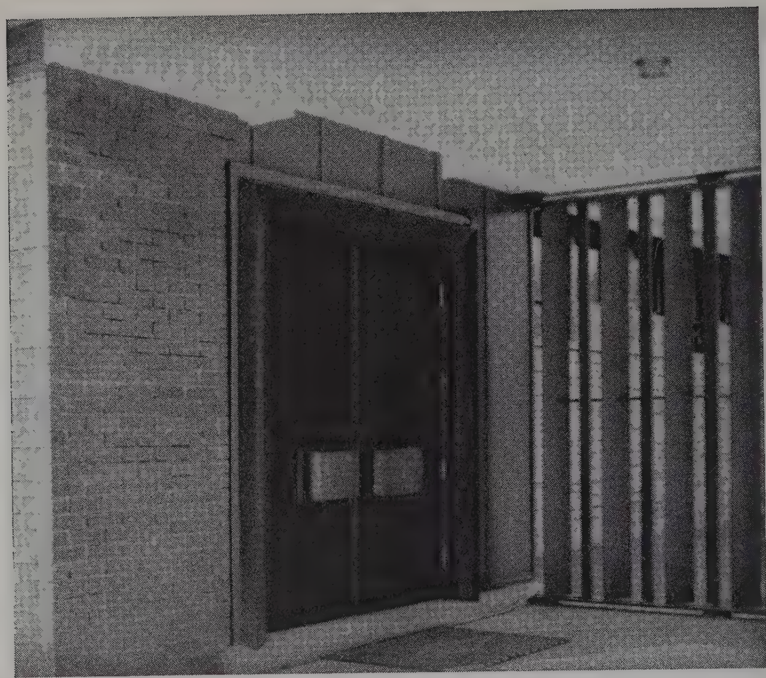
Laval-sur-le-Lac is a small, exclusive Montreal suburb populated for the most part by well-to-do people, nearly all of whom are French-Canadian. It is situated on the shore of the lake of Deux-Montagnes, and is a suburb noted for its stately houses, lovely lawns, shady trees, exclusive golf and boating clubs.

The congregation wanted to spend a maximum of $140,000 for a small church including rectory furnishings and landscape. Although the amount was low, they wanted something exclusive. To achieve their object they accepted a small church, seating 300, with no basement accommodation. The structure is laminated arches and purlins with a 2 x 6 shell covered with natural stone, brick veneer, and sheating. The steeple is steel covered with B.C. fir sheathing.

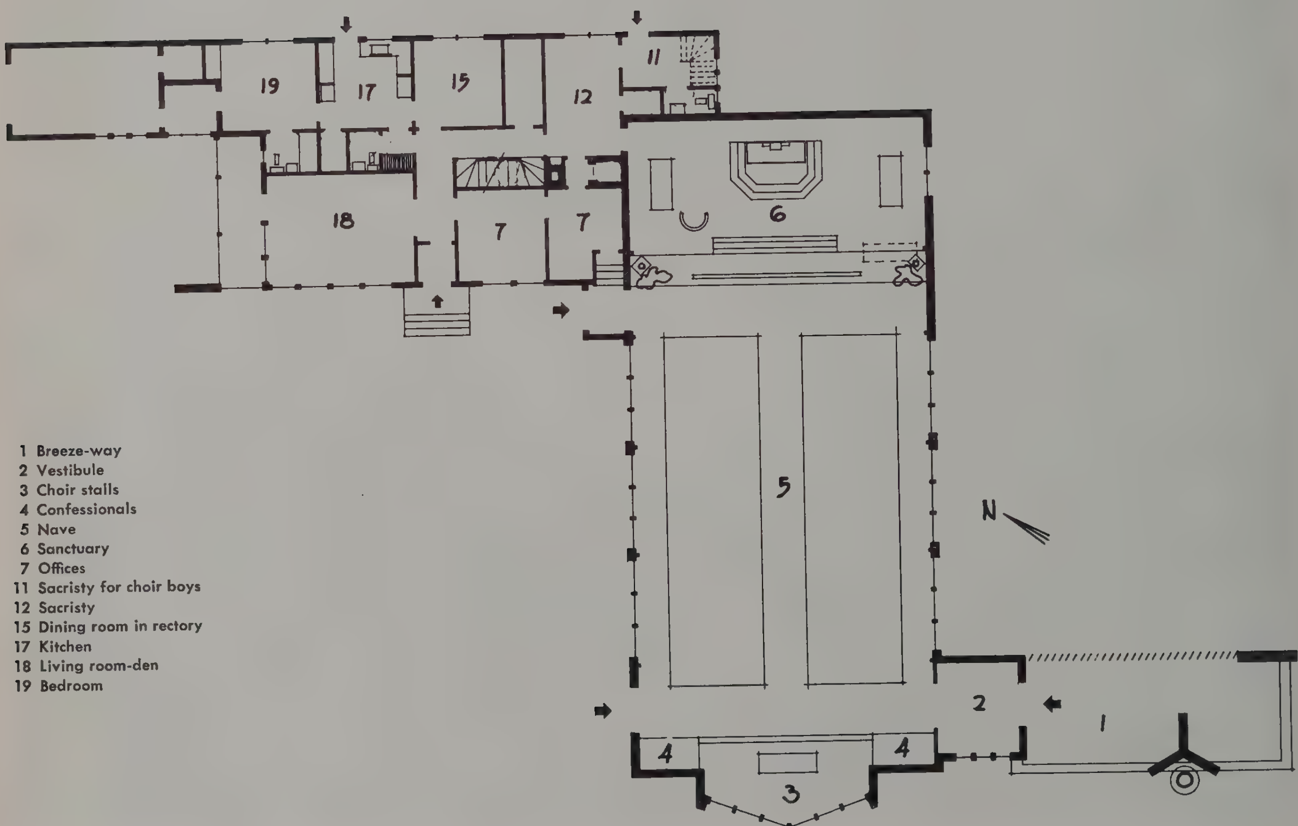
The large window (20 x 25 feet) in front is now of plain stained glass but will soon be of decorative stained glass. Flooring is rubber tile and panelling is selected stained ash finish plywood.

Cost of building	*$112,000.00*
Church finishing	*10,000.00*
Rectory finishing	*5,000.00*
Extras, sculptures, fees and landscape	*13,000.00*
Total	*$140,000.00*

STUDIO ALAIN



Entrance in covered porch



1 Breeze-way
2 Vestibule
3 Choir stalls
4 Confessionals
5 Nave
6 Sanctuary
7 Offices
11 Sacristy for choir boys
12 Sacristy
15 Dining room in rectory
17 Kitchen
18 Living room-den
19 Bedroom

The Way of the Cross

The Way of the Cross is executed in enamelled clay and was done by a young Montreal painter and sculptor, Mr Graeme Ross.

The Way of the Cross is mandatory in all Catholic churches but the mode of expression is free. Mr Longpré writes that he considers the treatment of the panel by Mr Ross to be exceptional in its naivety, sincerity and skill.

The same is true of the Corpus in the back of the main altar. A life size B.C. fir sculpture done by another young artist, Pierre Boivin of St. Hyacinthe.

Everything was designed for simplicity — in short, a silent place of worship.

STUDIO ALAIN

Journey to Peking

Sir Hugh Casson

"ARE YOU THE CULTURAL DELEGATION?" The flight clerk at London Airport looks up from his papers. "Mind you, I am only guessing." What else indeed could we be? Culture is written all over us. The Geologist, a tall, narrow totem pole topped with a scarlet craggy face that splinters into sudden laughter, a reserved manner, eyes blue and wary. A cigarette permanently trembles on his pike-like jaw. He is conventionally dressed in a tweed jacket and flannel trousers. So is the Poet – equally tall but equipped with the shoulders and haunches of a rugger player. He carries his head thrown back as though shocked if pleased by what he observes, wears suede shoes and carries very smart luggage.

The Philosopher – "half rodent, half fire-fly" as he in quotation, describes himself, thin, curly hair, with restless movements and sharp brown eyes, slight and dapper in a dark suit. The Sinologue, the delegation's young interpreter and dragoman, dark-haired, eager and diffident. He has yet to size up the dimensions of his task and remains politely deferential. From beneath a white Panama hat peeps out the tiny, seamed face of the Painter – a friendly tortoise peering from the carapace of the ulster which envelops him from chin to toe. He carries an unfurled umbrella and a shapeless shopping bag from which protrudes a sketch book and the trailing end of a pyjamas cord.

An odd bunch. (Three weeks later a Shanghai taxi-driver was to admit that he could not tell us apart.)

It is 8 a.m. Conservation is perfunctory and distrait. The spirits of the party are damped at the thought of the journey ahead and of complications left behind. I can guess what the others are thinking. We have all experienced the same reaction to the news of our departure – the raised eyebrow in the common room, the pursed lip in the bank, the facetious witticism in the club. None of us, I'm sure, is certain of any motive for going except that of curiosity. We are all aware that a guest – even at the house of his dearest friend – is always a prisoner and that beyond the Iron Curtain there are no bystanders – only players, and that even a decision not to play is a commitment in itself.

Yet none of us hesitated to accept the invitation – who indeed would have? And if our motives were doubtful our resolve was firm – or was till this morning. Victims of that terrible fate (to be members of a party in the composition of which we have had no say), we look ahead to a journey which experience tells us will be paved with memorials to compromises and tolerations of each other's peculiarities.

I ask what books my colleagues have brought. The Philosopher admits to Gibbon's *Decline and Fall.* (A private wager that this remains unopened I am later – but only just – to lose.) The Poet has a Loeb edition of Cicero's Letters, the Geologist a book on Buddhism. I privately feel that my own selection – Arnold Bennett's *Clayhanger,* Zola's *Germinal* (chosen for their thickness), Osbert Sitwell's *Escape with Me,* and Nora Waln's *House of Exile* (chosen for local colour) – might look less distinguished when collected from the wreckage of the crashed aircraft, but will prove better company.

The loudspeaker clears its throat and summons us out into the air. It is a lovely, pale, sunny morning. The dew still sparkles on the grass and a white mist lies over the meadows of Windsor.

Amsterdam finds us still depressed. The eyes prick with nostalgia as loudspeakers announce the flight leaving for London. I have not experienced this dull, trapped-dog feeling since going back to school. Over Czechoslovakia the sky is grey, sad and autumnal. I read and re-read the unreadable areas of *The Times.*

In Prague the knife of homesickness is given a further twist by the poignancy of a tiny homely label. "Thrupp and Maberly", on the sill of the taxi door.

September 15, Prague

Despite a friendly hotel, spirits drop to zero in this grey despairing city, visually ruined by the vast and vulgar memorial to the Red Army which now dominates the heights above the river. I have forgotten shaving soap, the Philosopher his razor. There is nothing gay in the shops – still less in the faces of the shoppers. The Painter says we are deathwatch beetles condemned only to go forward.

Next morning we complete our Chinese visa forms – fifty questions, the final one of which states "Please now write your autobiography" – and embark upon our first Russian aeroplane, twin-engined, tricycle-undercarriage, sturdy, turkey-carpeted and well kept. The stewardess, pale, and dressed in a blue-serge coat and skirt, welcomes us gravely aboard and hands round tea in glasses. Her hands are shapely, the nails pinkly varnished. At Minsk, where we are weatherbound for the night, we meet in the brand-new airport our first example of the contemporary Russian interior – fringed velvet curtains, serge table-

cloths, draped portières, cut-glass vases, huge oil paintings in heavy gilded frames, a Victorian preface to a Victorian country. The night in our dormitory is uneasy, and dawn, when we take-off, is a release.

September 16

The road from Moscow Airport to the city is marked with occasional hoardings advertising ice-cream and chocolates. The new university peeps over the horizon like some distant Camelot. The taxi is smart, glittering, slickly finished. The bustling, crowded city looks ramshackle, not because it is falling down but because it is being reconstructed. Everywhere are concrete-mixers and cranes and convoys of lorries. Old Chekhovian characters in high leather boots lead cows in and out of the scaffolding and brick stacks, among which a few old wooden houses sit like Oxford College barges, half sunk in the mud. The people seem cheerful but preoccupied. On the pavement a lorry unloads some household effects: an *art nouveau* hat-stand, a wicker baby-carriage, and a harp.

At the hotel the atmosphere is friendly and again indescribably Victorian with stuffed bears, bronze statuettes, brass spittoons, turkey carpets, high-capped parlour-maids. More and more does Moscow in 1954 look like Manchester a century ago. The same bustling development, the excitement of new railways and factories, the pinafored schoolgirls, the over-decorated buildings, the tyrannical working hours, the belief in progress, the confidence in self.

We visit the Red Square. I find as usual that it doesn't tally either with my imagination or with recorded accounts I have read. It occupies the crown of the hill so that, looking from one end, the far side is almost over the horizon. Facing the Kremlin (a collection of cracker hats peeping over a red brick wall and about as sinister-looking as a plate of biscuits) is an Edwardian department store flanked by a beef-red Gilbert Scott museum and the golden cruet of St. Basil.

Later we are conducted round the Kremlin – a magical architectural museum, yellow and white and grey and gold. It is being abandoned as a seat of government; certainly architecturally it could be hardly less suited to so materialistic and humourless a regime. It is as mad and highly coloured as a toyshop. Never again shall I read without smiling the familiar journalistic clichés . . . "lights burn late in the dreaded Kremlin to-night". . . . How could you dread so ridiculous and charming a place? The question dies on the lips, for as we cross the main courtyard, which is nearly as big as the Horse Guards' Parade, a manhole suddenly opens in the ground and two soldiers emerge. They replace the lid and walk purposefully away.

A few more days of sight-seeing. Stupendous productions at the Bolshoi Theatre, the new university, the art gallery (a splendid Rembrandt and three Renoirs fighting for space among the problem pictures of sick children, broken engagements, lost dogs, bereaved fathers, faded blossom, crumpled letters, plunging gun-teams), a shabby and wistful little zoo, and a nightmare trek round the Agricultural Exhibition. My main impressions: how hard the women work, how badly the men dress, how curiously rare are pictures of the Soviet leaders.

We enjoy Moscow but are angst-ridden by the delays. A series of visits to the Chinese Embassy (each one a démarche nearer home) eventually produces action (the weakness of the delegation at this stage for bad puns is a sign of incipient hysteria).

September 21

The aircraft is comfortable. The stewardess, woolly-jumpered and homely; knits in the back. The atmosphere is cosy. We land every few hours for fuel, and food in one of those incredible parlours: 10,000 ft. below is Russia. Yellowing larch forests, wide sandy-banked rivers, vast harvest fields, pine forests. After a few hours the eye gives up. There is no need to look out of the window, and no need not to. It's clearly unwise to invade a country of such size. Days – or is it weeks? – later we have reached Siberia. Sunshine glinting on the wings over the distant forests confirms that it is 11 o'clock in the morning, but by now neither time nor dates have meaning. Sunset and dawn, dinner and breakfast have been observed and eaten often, it seemed, in unfamiliar sequence. As the aircraft comes to rest, the delegation sits pole-axed by the fact of arrival. We know by now what lies before us – the courteous interpreter, the little flower garden, gravel-pathed and decked with monumental statues, that lies in front of the airport building – the spotlessly dusted parlour heavy with plush and chenille where we will wait.

Yet Irkutsk is different. It is a frontier town, the last port of call in Russia, within a few hours of Peking. Grey, deaf and crumpled, we retire to our dormitory for a few hours' rest. At three we awake for lunch, salad, soup, goose and compôte. The Painter settled down at the parlour piano, the rest of us return to bed. At 6 it is dark and I am joined in the little garden, where the red lights of the runway are reflected in the large aluminium bust of Mr Molotov, by a French film camera-man, eager to discuss the works of Le Corbusier. After ten minutes the conversation languishes because he knows so much more about that famous man, and so much more French, than I.

Suddenly, the lights fail. An airplane about to take-off buzzes angrily in the distant darkness. Around a candle in the parlour the party assembles as though about to hear a will read. The Poet and the Philosopher are playing piquet. Dinner is served at 9 p.m. by candle-light. The spirits of the delegation are low.

Thursday 23, 4 a.m.

We rise to see fog leaning against the windows. Departure is, of course, delayed. The Painter, overcoated and yellow-turbanned against the cold, returns to the piano.

At 10 a.m. the blow falls – the plane will not fly to-day, and, as if to underline our despair, the sun suddenly bursts through the fog into the tiny parlour. But it's too late. The Poet and the Philosopher shuffle the cards and the Frenchman retires to bed. The Painter returns to the piano. It's forbidden to leave the airport buildings as this is a frontier town. Overcoated against the frosty wind, I stand in the little garden watching more fortunate passengers board their aircraft.

Lunch is at 3 p.m. As we pick over our goose bones a detachment of khaki-clad, booted figures stamps in. The

Painter looks warily at them over his glasses. "How terrible," he observes, "to see soldiers who have not come to protect you." But they are not soldiers. They're a Parliamentary Delegation from Rumania – clearly more important than we are.

After lunch I return to the garden to do some sketching. This is clearly unwise – a few minutes later a policeman takes the sketch book (and me) to the interpreter, who eyes me sadly. "Drawing," he says, "is not necessary." By dinner-time the morale of the delegation is at its lowest. The Rumanian delegation has taken over our table in the restaurant. We have no roubles and can order no drink. We go to bed early and endure a poor night. Aircraft arrive and depart at frequent intervals, the noise of their engines bumping round the dormitory like thunder-claps.

The 4 a.m. summons is welcome. Miraculously, there is no fog, and after a quick breakfast we board a Chinese-Soviet aircraft. The wings are cleaned of frost by a quick hosing with hot water and we take off into the first red streaks of dawn. Below us is Lake Baikal; larger, we are told, than Belgium and the deepest in the world. Ahead lies Mongolia and the distant snowcapped peaks that guard the approaches to China.

The flight from Siberia is one of mounting excitement. Forests yield to the milk-chocolate-coloured desert plateau of Mongolia. We land to refuel on a lonely airfield guarded by a row of supercilious camels. Two huge glossy taxis meet us (where have they come from?), but, finding no customers, drive off resignedly into the empty landscape. . . . Where to? An hour later the desert ends abruptly in a shelf spilling rusty stains down into the valley. Fields appear; crumpled hills; vast flooded valleys; tiny walled cities; and then between two pagoda-tipped mountains the plain of Peking, and in the distance the great hazy square of the city itself. There must be few cities in the world with so dramatically beautiful an approach.

Below on the airfield we can see a guard of honour, a dais, a brass band. The Geologist, our official leader and spokesman, looks apprehensive. "Surely," he says, ". . . it can't be . . . ?" Vanity and alarm shuffle for supremacy as we straighten our ties. We emerge into blinding sunshine and an agreeably flattering knot of pretty little girl Press-photographers with scarlet-bowed plaits. We are borne off by our beaming hosts, by-passing the band which is practising the Rumanian National Anthem. Now we know who *that's* for.

Swinging through the aircraft gates – yes, there's the electrified fence we had heard about, but why had nobody told us it was hardly three feet high? – the convoy of cars trails its dust towards the city. The road runs straight between market gardens peppered with little tombs and monuments. Blindfolded donkeys circle endlessly round wells; cabbage fields surge up to the new factories and office blocks crystallising behind their bamboo scaffolding. No sign of tower cranes or bulldozers.

Suddenly the city wall appears, lofty and grey. Behind it lie the streets of Peking, straight, lined with single-storey houses and shops, and filled from side to side with surging blue-clad crowds. Men and women, boys and girls, all are in blue, dark blue, light blue, sky-blue, grey-blue, ink-blue, sea-blue. Every face seems to be smiling and cheerful, everyone madly busy, except those last and disapproved relics of private enterprise, the rickshaw owner-drivers dozing comfortably on the ranks.

We reach a great boulevard, down the centre of which the ancient flag-decorated trams screech and rock beneath a fantastic cat's-cradle of wires and cables. At every corner is a smart traffic-cop controlling the crowds through a scarlet megaphone. Even to aircraft-deafened ears the noise is bewildering and perpetual. Cars are few, speeds are low, but horns are permanently wedged down and street-sellers' cries, squeaking cart-wheels and bicycle bells add to the clamour. Even more than Oxford or Copenhagen, Peking is a city of bicycles. They shoal like silver herrings down every street and alley. The prevailing colours: grey buildings, blue-clad people, touches of scarlet from flags and ribbons. There are, it appears, no privately owned cars, and the largest limousines are curtained – for protection against sun and dust or as a symbol of rank (like a Civil Servant's carpet) or of sinister private power?

In the middle of a laughing crowd a horse doctor administers a pill to a mule lashed to a tram standard. Pigeon flocks flash black and white, carving the sky like sword sweeps, but there seems to be no cats or dogs. Everything is spotlessly clean – washed gutters, swept pavements, sacks prudently slung beneath the tails of mules and donkeys. A child squats outside a shop door while the shopkeeper waits courteously with dustpan and brush until it has finished. Children swarm everywhere, squeaking and tumbling on the pavements, rocking down the alleys on their tiny legs "like little taut spinning tops" (during the whole of our stay we never saw a child in tears, nor a child barefooted). The long trousers of the infants – boys and girls alike – are slit between the legs – a draughty but practicable device. A child in China presumably graduates not, as in the West, from short trousers to long, but from open trousers to closed.

The boulevard opens out into Red Square. On the scarlet-walled, golden-roofed gate of the Imperial Palace hangs a large coloured picture of Mao Tse-tung. Opposite are a few nondescript office buildings, and a giant monument under construction. Remembering Prague, we fear the worst here. We turn off through the sentries and shining brass plates of the Legation quarter, past a few hideous Edwardian Baroque relics of the twenties, to reach our hotel – just completed. It is a pleasant, orderly looking building. Western in style but with agreeably Chinese details at roof level and round the entrance doors. Within are all modern amenities (lifts, hairdresser, private baths, Sheffield cutlery, dancing on Saturdays), plus Chinese extras (slippers, fresh fruit, vacuum flask of hot drinking water in every room). Fifty yards in front of my bedroom window rises the south wall of the inner city, its battlements crisply outlined against a clear China-blue sky.

We descend to the diningroom for our first meal. Here the round tables are for Chinese food, square, for European. We sit bravely at the former and pick up our chopsticks. From that moment we are the willing, not to say enthusiastic, slaves of Chinese cooking – surely about the most subtle and imaginative in the world. The hotel is packed with delegates – parties from Pakistan and Indo-

nesia, from France and Central Europe, from Italy, Germany and Japan, plus a few "jokers" like ourselves. A cancer surgeon from Chile, one or two professional and paunchy delegates to World Youth Conferences, a novelist from Sweden, a Dutch photographer, a British artist. Interpreters, patient, smiling, quick to anticipate any want, shepherd their parties like little grinning sharp-eyed sheep-dogs. Our party is still a little prim and purse-lipped in such company, but already falling to the spell of China and its people.

* * * *

In lovely weather – warm sun, cold breeze, clear blue days and Mediterranean nights – the week passes crammed with sightseeing. At our request we eschew factories and clinics, mines and blast-furnaces. For us, day after day, are spread out the delights of temples and gardens, of palaces and lakes, of secret courtyards and absurd pavilions with delicious elegant names: "The Palace of Pleasant Sounds," "The Studio of Pure Fragrance," "The Hall of Vast Virtue," "The Pavilion for Watching the Spring." All are beautifully kept, affectionately restored, crowded with visitors – soldiers strolling with linked fingers, old ladies tottering on mis-shapen feet, pale-faced Europeans hung with light-meters and scribbling in notebooks, parties of school-children in scarlet scarves.

We stroll along beautifully patterned pathways past the agonised rocks and twisted cypresses of the Winter Palace, where an old man, white-masked against the dust, sits silently appraising goldfish. We descend through a dark twisted cave in the Peihai Park to reach a canopied ferry in which we are carried across a lake to the Emperor's fishing-pavilion. We drink tea in the shade of the Temple of Heaven, eat a picnic lunch among the yet unrestored ruins of the Summer Palace, doze in the sun beside the hulk of the old iron steam yacht (a present from the Emperor of Japan to the Dowager Empress of China) that lies mildewing and desolate upon a marble quay. We watch butterflies by silent pools, and listen to magpies in the bamboo groves. We are taken to see Mr Ching Chin-yi, who, in the shade of a little pavilion, is busy engraving the Stockholm Peace Appeal upon a grain of rice. We move in a stupor of visual delight.

* * * *

But not all days pass in such languorous activities. The Geologist bumps off into the hinterland to probe the mystery of the Peking Man. (Is he in Japan, in America, or just a missing casualty of the war?) The Painter draws busily in a studio set aside for his use in the Art School. The Philosopher gives a lecture at the University on Logical Positivism. In a talk to the literary circles of Peking, the Poet draws gentle but firm attention to the pitfalls of translation. I add my quota of warning to the local architects and students against the danger of adopting current Soviet architectural styles. We visit the opera and the cinema, museums, schools and galleries. We take part in hard-hitting debates with our Chinese colleagues, where only occasionally is the blind of dogma suddenly drawn down.

Every day there is a banquet, a reception or an official function. At one we are given sea slugs and Peking Duck to eat. At another we attend the formal (if foreseen) election of Mao Tse-tung as Chairman. Here our foreign delegate colleagues are seen at last at ease. The clamour of flood-lights, movie cameras, the familiar setting of rostrum and agenda, of voting papers and points of order, to them is familiar country. Lapel badges flash, pince-nez glitter happily, notes are taken. At a third we listen for hours to official speeches (the Soviet representatives speak longest). At a fourth, before the half-horrified, half-envious glances of my friends, I manage to secure, by elbowing aside a top-booted Bulgarian girl folk-dancer, the autograph of the Dalai Lama – a grave, spectacled young man in a golden-yellow topee. At a fifth we formally present our message of good will to the Chinese colleagues and are loaded in return with gifts and compliments.

We are shopping in the bazaars. "Here," says the interpreter, pointing at a barrow-load of berets, "you can buy some heads for your children." In search of silk we penetrate into one of the old courtyard houses of which Peking is still largely composed. Once a large family dwelling of three courtyards devoted to servants, to guests and to the family circle, it is now divided into separate dwellings and workshops. To the outside world – an alley no more than eight feet wide – it presents merely a narrow gateway in a long grey wall patterned by a single tree. We discover old friendships when we are most hospitably entertained in the British Legation resplendent with new scarlet paint and well-weeded lawns. "No Hooting," says a notice by the gate. "Divine Service will be at 10.15."

* * * *

Flattered, sun-tanned, replete, the delegation unashamedly enjoys itself. And yet, of course, there is always present the pricking thorn in the bouquet. We do not discuss politics directly with our hosts. Behind the smiles, the courtesy, the disciplined efficiency, the irresistible charm of the Chinese, lies . . . what? Still the age-old contempt for the barbarism of the West, even sharper now that it is harnessed to the mental tyranny of Marxism? We see what we see. Is what we do not see, or even what nobody can see more significant? The Government is obviously in full control. The Government is popular. Communism is popular. Is there any opposition? Who knows, even in the Government, what it is, where it is, how big it is.

It is possible to forgive the inane, parrot-like clichés, the bureaucracy, the fear of personal responsibility. No nation has a monopoly of these, nor for that matter of stupidity and cruelty. Merely to list examples of them is a waste of time. Yet as every traveller to Orwell-land soon finds out, he cannot remain a referee. He must play on one side or the other, and to refuse to play is itself a commitment. You can respect the vigour and strength of a new system that has brought stability and dreams of untold industrial prosperity to a nation that is no doubt accustomed to tyranny, but to yield such respect means that you must also accept the basic premises of the system – the distortion of truth, the insistence upon official infallibility, the mutual suspicion and informing, the closed frontiers, the need for the accused man to prove his innocence and not the accusers his guilt. To an effete Liberal Barbarian from the West these are all unacceptable, and no number of remarks about omelettes and breaking eggs

will convince me otherwise.

For us, National Day is obviously going to be also a difficult day. It dawns warm but overcast. We are woken early by the sounds of distant bands and the cheers of children cascading past the hotel carrying green and pink paper flowers. The Painter has contracted out on the excuse of disliking crowds. We and all the other delegates arrive by well-organised circuitous routes at the review stands beneath which have been built tea-rooms and lavatories. The atmosphere is festive despite the knowledge that there is four hours standing ahead of us. A crane with stiff legs trailing cruises slowly overhead.

At 10 a.m. sharp the parade begins. Massed bands, a salute of guns, flags barely stirring against the grey, close sky. For nearly a minute there is a dramatic silence, broken only by distant shouts of command. The march-past begins. White-gloved soldiers doing the goose-step, popular little Mongolian ponies, tanks and guns: troops – a horrid sight this – packed like jerking toys in lorries. Around us, in the stands, beam the mild faces of the Fighters for Peace, faces that we have seen above a hundred platforms. Gold-rimmed spectacles misted with emotion, cheeks creased with years of well-meant service in this cause or in that, shirts defiantly open at the neck, badges in lapels, and there in the middle – could it have been? – an M.C.C. tie, they watch the military ironwork clattering by.

Eventually it is the fatuity of their expressions rather than the menace of foreign armour that drives the Philosopher and me from the stand as soon as the minimum time for courtesy has been expended. Here we sit over tea discussing the prim futility of our gesture, the self-justifying gymnastics in which every traveller behind the Iron Curtain is constantly and inevitably engaged. I propound my pet theory for military parades – that they should always take place in another country. In other words all peoples would gaze upon – and if necessary be awed by – the display of another country's military strength. This might encourage more peaceful, or at any rate more respectful, states of mind and would keep the armies of the world busy packing up to go from one place to another.

While we wait an interpreter comes to ask if we would like to be photographed on the Stand. We refuse – we hope politely – and once again chafe at our puny and illogical gestures. After all, we are here – why object to a record of our presence? We do not return until we hear that the students, the workers and the children have taken over from the soldiers.

Pink, white, scarlet and road-wide, the torrent of singing cheering people passes carrying cardboard locomotives, portraits of Stalin and Mao, dancing with coloured scarves, releasing coloured balloons, pigeons, model aeroplanes and kites. On the far side of the road more children raise and let slowly fall branches of pink and white blossoms like waves breaking on the shore. At 2 p.m. exactly the last child totters past the saluting base where, for the past four hours, Chairman Mao and his Soviet guests have been taking the Salute.

It has been an impressive, efficient and brilliant, and at times most moving spectacle. But more moving than this is the drive back to the hotel through streets lined throughout their length with smiling, clapping crowds. Beside me in the bus a trade union delegate sits with tears running down his face. In the evening there are fireworks – surely done here better than anywhere else in the world – and there is dancing in the streets until midnight in the light summer rain. It is comforting, in some curious way, that rain falls impartially at times of national celebration on both sides of the Curtain.

National Day over, we journey further afield. A five-hour flight over the vast flooded plain of the Yellow River dotted with village islets – raisins floating in coffee custard – brings us to Shanghai. The usual reception party of courteous smiling "Artistic literary circles" meets us at the airport . . . "Or else" . . . mutters somebody cynically. Maybe, but their welcome is warm enough. Despite this hospitality and the comfort of our hotel, spirits are low. Shanghai is as ugly and bustling and indistinguishable from Toronto or Liverpool. Skysigns, smoking factory chimneys, Oxford-street like shop hoardings, trams, wire-scape. There are signs of under-employment and the big Wimbledon-like villas of the old business magnates, half-timbered, romantically gabled and chimneyed, now hostels or clubs, look neglected and forlorn. A visit to Tung Chi University revives our interest, which flags again at the house of Lsin Hsin – the Gorky of China – and his home is preserved as a museum. The Philosopher – who has clearly visited Anne Hathaway's Cottage, chafes at this piece of hagiography . . . where not only the books and furnishings but the yellowing cigarette holder, the balding hairbrush, the stomach pills and the plaster death mask of the writer (sprouting "genuine moustache hairs") are preserved with solemn care.

A special wagon-lit – again with the slippers, the refreshments, the perfect service – attached to the regular express takes us to Hang Chow – China's famous beauty spot and holiday resort. It is midnight when we arrive but the Literary Circles are again on parade at the station. The air is soft as milk, heavily scented and loud with the noise of frogs and crickets. There is a mosquito net over the bed in the hotel. Daylight reveals a landscape of lakes and islands pricked with tiny pavilions, ringed with green hills that lie still and painted in the breathless heat. "Once a dilapidated health hazard", says the guidebook, "this is now a National Park of rest." A blue and white canopied gondola – with a table set centrally for tea – takes us from islet to islet. Butterflies dance, fish jump, lilies yawn in the sun. We drink tea and eat lotus porridge. The Painter does an hour-long study of a willow leaf. The Geologist caresses a rock but does not sigh for his hammer. The Poet and Philosopher are silent. Culture, visual curiosity, energy drain almost audibly from the delegation's fingers trailing in the pewter coloured water of the lake. But next day we return happily enough to sight seeing.

Here in the south temples are slightly different – roofs curl more daintily up at the corners in a coquettish flounce of petticoats. Colours are softer. Through low caves lined with Buddhist carvings schoolgirls swoop and chatter like starlings. Outside, an old man watches a dead praying mantis which in its death-throes has disgorged a writhing bronze-coloured worm more than twice it's own length. A bearded monk tells our fortunes in a dark temple. In a

thatched cottage where scrawny hens peck and scratch under the sewing machine, an old man reads the local paper which – as we know – contains an account of our arrival. What, we wonder, does he think as he spells out to himself our strange names and even stranger accomplishments? We climb through gently steaming bamboo groves to take lunch in a mountain temple where the mist swirls eerily through the courts and pavilions, and we are greeted on our descent by a party of sailors carrying yellow umbrellas who clap us politely as we wheeze past. By now the delegation itself is something of a dilapidated health hazard!

We attend a banquet in a lakeside restaurant and are enchanted by an opera performance at the local theatre – too soon we are homeward bound, savouring for fully ten minutes the experience of a special train – a wagon-lit and its engine, which carries us proudly from a siding to the main line.

Scarcely fifty miles from Peking lies part of the Great Wall of China, – the only man-made structure, as we were taught at school, which would be visible from Mars. White-masked like internes against the dust the delegation, loaded with picnic lunches, drives off to see it. In the dashboard of the car the driver's tame cricket chirps away in its gold and scarlet little cage. Peking drops away into the dusk, the mule carts with the loads and snoozing drivers thin out, the villages are spread further apart. We cross a river bed and start climbing. Beneath us by a stream a fisherman sits with half a dozen camels watching scornfully over his shoulder. Across the valley a freight train – its engine scarlet-wheeled, brass-bound and hissing like a dragon, grinds its way slowly up the pass. Near the top of the pass we leave our cars. There is no sound but the tinkle of camel bells, the clatter of the river, the distant laborious puffing of the train, and every now and then the determined enquiring tap of the Geologist's hammer. Suddenly, round a bend, there it is, perhaps a little less high than expected, snaking over the craggy crest of the hills, punctured by watch towers, grey and glittering in the diamond bright air. As always, when confronted with a world famous monument, the eye is ill at ease, blinkered by preconceptions, over-eager to be pleased, pathetically anxious to avoid disappointment. But the Great Wall does not disappoint. It is difficult indeed not to touch its ruled, patterned stones without emotion. Savouring every moment we climb the steps up on to the paved ramparts. Immediately below us is a flock of white goats. A few hundred feet below them a tiny village – there is a crowd in the market square – an open-air theatre? a political meeting? – the shout and music drift up faintly to our ears. Below that again the great wide valley, flat, grey-green stitched with field divisions, patched with villages, threaded by the thin straight seam of the Trans-Siberian Railway. Beyond, snowtopped, are the mountains of Mongolia. It is like Greece, like Spain, like South Africa – like nowhere on earth. Reluctantly we rejoin the cars and bump off down the mountain trail. A scarlet coffin on a creaking mule cart disappears in the dust of our passing. An hour later we are in the valley of the Ming Tombs – a natural amphitheatre a mile or two across and surrounded by low hills and approached by a long avenue guarded by vast silent stone animals – elephants, horses, dragons and camels. In each fold of the hills lies a Royal tomb, some almost hidden from sight. Here restoration work is only just beginning and the atmosphere is pleasantly melancholy. The later afternoon sun fills the deserted courts as though with golden syrup, and grey long-tailed birds call and flutter in the cypresses. A loose tile rattles in the evening wind. The colours are faded, grass grows high between the stones and over the roofs. Far below us we can hear the car drivers talking by the entrance gates. For the first time I feel very far from home.

Visa delays – a Russian transit visa, intending travellers please note, means you can cross Russia one way but not the same way in reverse direction – enable us to visit one of Peking's favourite "raree" shows – the Institute of National Minorities. Here a few miles outside the city wall in pleasantly undogmatic stone buildings some 1,300 students and 220 staff from approximately 46 nationalities live and work together under the ebullient Director Fei – once himself a student of sociology in London. Over tea in the antimacassared reception room the policy is explained. Outside the window a steam roller chuffs cosily to and fro. The Chinese nation, we are told, consists of many nationalities minority groups – each with its own culture and language and all in different stages of development. The Government believes that the minorities should be encouraged to preserve their separate cultures and ways of life, but that they should be helped to develop along similar lines to similar standards by political administration and linguistic training. Potential leaders are brought to the Institute for training over a period of eight months to two years and then return home as teachers and administrators – presumably having absorbed the correct dose of Marxism with other more useful knowledge. While in residence the students are encouraged to wear their national costume, to eat their national food – there are six different dining rooms – and to follow their own forms of religion.

"Suppose," we ask, "a national group has a spoken but no written language". "Then," says Director Fei with a 100 candlepower smile, "if it is practicable we construct one." The steam roller hisses comfortably to itself. "First we record the sounds phonetically in the Latin Script. Then we, the teachers, attempt to analyse it, to construct rules of grammar to write a simple textbook. At this stage the teacher is learning from the student. Now it is reversed. The teacher teaches the student how to write his own language . . ." The smile broadens . . . "and then soon the student goes home and becomes again the teacher!" Director Fei is convulsed with delight, and his enthusiasm soon affects us all. Proudly he shows us the school notice-board, a mad fantasy of writing – vertical, horizontal, left to right or vice-versa. He invites us to taste Tibetan lunch and to look in at the mosque, to see the Mongolian students dancing. Notebooks in hand we trot at his heels, for he moves through his corridors like a good natured whirlwind.

As we leave to a final flash of teeth I see the steam roller still placidly chuffing up and down its tiny stretch of tar-

(continued on page 357)

Stability and Durability of Masonry Materials

Neil B. Hutcheon

Dimensional stability and durability are two major requirements common to all building materials. Since no materials are perfectly stable and durable even within the range of conditions provided by the weather, it becomes necessary to recognize the limitations and difficulties inherent in this situation.

The need for durability is, at first glance, rather more readily appreciated than the need for dimensional stability. A building material must maintain its properties within reasonable limits so that it will continue to serve its function in the building construction for the required length of time. Most building materials must be durable for the life of the structure, that is for fifty years or more. The evaluation of the durability of a material becomes a difficult task since it can finally only be proven by the passage of time.

It is no longer possible, in this age of rapid technological development, to wait fifty years or more for the evaluation of the durability of a proposed new building material. Ways have to be found of assessing materials in a few days or weeks in the laboratory by means of accelerated aging and weathering tests. Again, however, as with the materials themselves, these methods can only finally be proven by the passage of time.

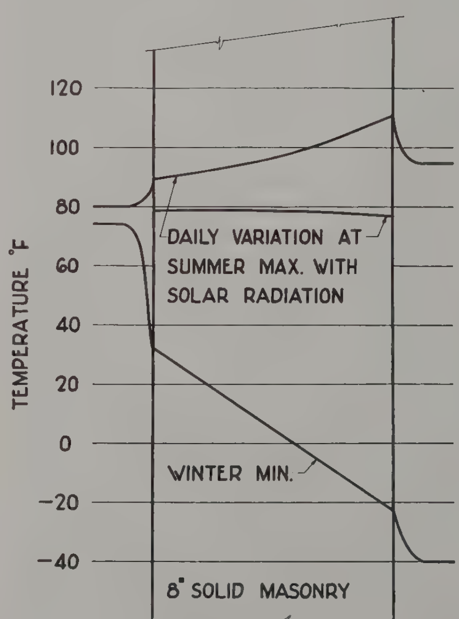
Dimensional stability and durability are not unrelated. A material which exhibits marked expansion and contraction with changes in temperature or moisture content may, under certain conditions of use, be capable of destroying itself through these mechanisms. Dimensional changes are of importance when they become large enough to create significant stresses within a material or a combination of materials or in a structure as a whole. The designer must continually be on the watch for the possibility of such "self loading" and must make appropriate allowances where these conditions cannot be avoided. It is safe to say that many of the refinements in the use of masonry materials which may be expected over the next few years will be in the direction of a greater realization of the dimensional changes which may take place in these materials, coupled with improved ways of dealing with them. In some cases it will be possible to modify a material to improve its dimensional stability. In other cases, certain materials may have to be avoided, and in still others it may be possible to find new ways of minimizing the ill effects of dimensional change.

Thermal Expansion

The dimensional changes in materials brought about by changes in temperature are well known. Thermal expansion is to a large extent inherent in materials and is not normally subject to much adjustment through modifications to the materials. The effects of thermal expansion in building construction are not nearly so well recognized as they ought to be, particularly in Canada where the normal ranges of temperature are relatively very great. Materials exposed to the weather may experience a range of temperature of 140° in many parts of Canada. It is not difficult to demonstrate by calculation that a 20-foot spandrel beam, for example, will change in length by one-eighth inch upon a temperature change of 70° and that if this deformation is fully restrained, as it might tend to be in a long steel structure, the corresponding axial stress that could be developed is 14000 p.s.i.

Serious stresses resulting from restrained thermal expansion are not confined to steel structures. Temperature variations throughout a plain 8-inch masonry wall for ex-

Fig. 1



Yearly temperature throughout a solid masonry wall for air temperature range — 40° to + 95°

treme Canadian winter and summer conditions are shown in Fig. 1[1]. The variation in outside surface temperature is 133° and the potential change in length for concrete is 1.1 inch in 100 feet. If fully restrained the corresponding stress developed in a normal concrete would be about 2300 p.s.i. The gradient in temperature is largest in winter, being about 7° per inch. Under conditions of no restraint this would result in a camber of 2.2 inches in 50 feet of height or length of a wall initially plane, and if restrained would result in a stress in normal concrete of about 1000 p.s.i.

Fitzmaurice[2] gives figures on the magnitude of the stresses likely to be produced in walls of various brick-mortar combinations with restrained thermal expansion. The stresses for a 27°F rise in temperature (15°C) are shown to be from 6 to 14 per cent of the failing stress in compression, the highest value being for strong brick in cement mortar. Somewhat similar results can be expected for stone masonry. It need hardly be emphasized that temperature changes and temperature gradients will lead to cracking of masonry under Canadian conditions.

This situation in respect of thermal expansion which has been dealt with at some length is quite similar in many respects to the situation created by other dimensional changes which are now to be discussed.

TABLE I‡
THERMAL AND MOISTURE EXPANSIONS OF VARIOUS MATERIALS

	Thermal expansion % length change for 100°F	Expansion on wetting % length change	Modulus of elasticity x10^{-6}
Limestones	.01 to .05	.002 to .01	3 to 10.4
Clay and shale bricks	.02 to .05	.002 to .01*	1.4 to 5
Concrete	.05 to .08	.01 to 0.2**	2.5
Steel	.067		30
Portland Cement Mortar	.04 to .06	.005 to .028	3.5
Lime Mortar	.04 to .05	.001 to .019	.5

*Highest expansions with soft burned bricks
**Depends greatly on aggregate. Lightweight aggregates give high expansions.
‡Composite of data from several sources

Dimensional Changes due to Moisture

Almost all masonry materials exhibit dimensional changes with changes in moisture content. The significance of these may be judged from the data of Table I. To assist in this, the thermal expansions are expressed on a basis of per cent change in length for 100°F, and may be compared directly to the expansions on wetting, also given on a per cent length change. It will be noted that the length changes possible upon wetting are appreciably less than those which may be expected from temperature change (100°F) for limestones, clay and shale bricks, and lime mortar, and are greater only in the case of some concretes. The stresses set up as a result of moisture changes will generally therefore be less than those previously indicated for temperature changes, but may still be significant.

The differences in wetting expansion between lime and cement mortars and between cement mortar and clay and shale bricks may be noted in relation to the "compatibility" of bricks and mortar. Volume changes in brick masonry materials were the subject of study by Palmer of the National Bureau of Standards in 1931[3]. He concluded that "differential volume changes between brick and mortar caused by variations in moisture content are apt to be greater than those produced by normal temperature variations".

Initial Shrinkage

Another pertinent dimensional change is that which is likely to occur during the setting and curing of cementitious materials, or of mortars and concretes containing cementitious materials. These shrinkages are much greater than the subsequent changes due to wetting and drying. Palmer found shrinkages ranging from 0.11% to 0.27% for eleven portland cements made up in 1:3 mortars, and from 0.30% to 0.55% for 1:3 lime mortars.

Initial shrinkages may be expected to vary widely, depending on mixes and curing conditions.

Freezing Expansion

Still another important dimensional change occurs when masonry materials are frozen while wet. It is interesting to note that the less durable materials exhibit the greatest expansions, and that expansions of the order of 0.02% were found by Palmer to result from 20 cycles of freezing and thawing for certain soft or under-burned bricks. The results for a number of these which were disrupted by the treatment were not included in the figure given.

Thomas[4], working in England with building stones, has also studied the deteriorating effects of freezing of wet materials and has demonstrated that the degree of saturation at the time of freezing is of importance.

Absorption of Water

The extent to which masonry materials will absorb water has long been recognized as an index in their assessment and many specifications set limits upon permissible absorption. More recently attention has also been directed to the importance of degree of saturation, of concern in freeze-thaw deterioration, and to initial rate of absorption which is of primary interest in the case of bricks.

All common masonry materials contain some amount of void or pore space within them. This can be a small percentage of the total volume of the material as in the case of some dense building stones or a relatively high percentage as in the case of many clay bricks and building stones. The ease with which this void space can be completely filled with water varies with the material and with the conditions to which it is exposed. It is now known to be very difficult to achieve perfect saturation although this can be

[1] Hutcheon, N.B., Fundamental considerations in the design of exterior walls for buildings. National Research Council, Division of Building Research, Ottawa. NRC No. 3057. 1953. 25p.

[2] Fitzmaurice, R., Principles of Modern Building, Vol. 1, Walls, Partitions and Chimneys. Department of Scientific and Industrial Research, His Majesty's Stationery Office, 1938.

[3] Palmer, L.A., Volume Changes in Brick Masonry Materials. U.S. Department of Commerce, National Bureau of Standards, Journal of Research, Vol. 6, 1931.

[4] Thomas, W.N., Experiments on the Freezing of Certain Building Materials. Department of Scientific and Industrial Research, Building Research Station Technical Paper 17. London, H.M.S.O., 1938.

approached in the laboratory by first evacuating the air, or, in a more practical way, by boiling.

The range of absorptions of Canadian bricks from three sources are given in Table 2. Also shown is the initial rate of absorption, expressed as the grams of water taken up through 30 square inches of brick face immersed one-eighth inch in water for one minute, and the "saturation coefficient" which is the ratio of the absorption on the cold and boiling tests.

TABLE 2[5]
BRICK ABSORPTION PROPERTIES

		Initial Rate of Absorption or Suction (grams/30 sq. in.)	Absorption on total immersion 24 hours (% dry weight) C	Absorption on total immersion in boiling water 5 hours (% dry weight) B	Saturation Coefficient C/B
Brick A (dry press shale)	(1)	54.5	6.2	8.5	0.73
	(2)	104.7	8.7	11.5	0.75
Brick B (extruded shale)	(1)	2.2	0.9	2.4	0.41
	(2)	6.0	3.6	5.2	0.71
Brick C (extruded clay and shale)	(1)	35.2	12.5	15.1	0.83
	(2)	41.9	13.4	15.8	0.85

Samples (1) and (2) of same lot of bricks show range within the lot.

Durability under Freeze-thaw Conditions

The extent to which a material is damaged in freezing is known to depend on a number of factors, which include its degree of saturation with water when frozen, the rate and number of times freezing, the strength and elastic properties of the material and the nature of the pore structure of the material. Thomas found for a number of stone samples that there was a degree of saturation in each case below which no damage from a single freezing could be detected. These limiting saturations covered a range from 71 to 90%.

For present purposes the mechanism of damage may be considered to be due simply to the expansion of water to the extent of about 9% by volume upon freezing. This sets up stresses in the material which may weaken it or even disrupt it. The larger the proportion of unfilled pore space at the time of freezing the less likely are these stresses to be developed. Actually there are other complicating factors to be considered, such as the lowering of the freezing point of water when dispersed in fine pores, and the plastic nature of ice which causes it to flow under load if given sufficient time.

Freeze-thaw durability is measured in the laboratory by noting the progress of the deterioration as the material is subjected to repeated cycles of wetting and freezing. There cannot yet be said to be a universally accepted standard for this determination, and much work must be done in standardizing this test and in correlating the results with service conditions. Despite this, the freeze-thaw test is now accepted as a basis for the standard brick specifications of ASTM and of CSA, and for the evaluation of concretes.

Different degrees of severity of exposure of bricks in regard to frost action are recognized in both ASTM and CSA specifications and bricks are classified in three grades, "SW", "MW", and "NW", providing different degrees of resistance.

Grade "SW" bricks are intended for use where high degree of resistance to frost action is desired and the exposure is such that the brick may be frozen when permeated with water.

Grade "MW" bricks are intended for use where exposed to temperatures below freezing but unlikely to be permeated with water; as a typical example, brick used in the face of a wall above grade.

ASTM grade "NW" bricks are intended for use as back-up or interior masonry, or if exposed, for use where no frost action occurs.

The basis of these classifications is the reaction of bricks to a standard freezing and thawing test, in which the saturated bricks are frozen and thawed, under certain conditions, 50 times. Bricks which are virtually unaffected by this treatment are classed as grade "SW"; if certain slight changes occur in bricks from the treatment, they are classed as grade "MW". Disintegration of the bricks by the freezing and thawing treatment places them in the grade "NW".

Since a correlation between the properties of bricks of "saturation coefficient", compressive strength, and water absorption and the reaction of bricks to a standard freezing and thawing treatment of 50 cycles has been determined, it is possible on the basis of these properties, to classify bricks into the ASTM grades. This enables comparatively quickly made measurements to take the place of the relatively long freeze-thaw treatment, and an indication of the frost resistance of the bricks is obtained.

Moisture Migration

Since the effects of moisture in materials are of such importance in determining their performance there is a need for understanding the ways in which moisture may enter, migrate in, and leave a material.

Water can enter and move within a material only under the influence of some potential. It follows that water held in a material at a given concentration must be at a given potential or free energy level. When a material is saturated at atmospheric pressure, the potential, or free energy level, is the same as that of free liquid water at the same temperature. Water held in a material under conditions of partial saturation is therefore at some definite but lower level of potential. The forces to hold water in a material at such a depressed level of potential, relative to free water at the same temperature, may be provided by several kinds of forces, including surface and capillary forces acting on water within the material. It is sufficient for present purposes to note that these potential or energy levels can be described and measured for various conditions of temperature and moisture content for a particular material.

If two pieces of the same material, one wet and one dry, are placed in contact there will be a movement of moisture from one to the other until the potentials are equal. Similarly if water is put on one end of a piece of dry material it will gradually distribute itself until the potentials throughout the piece of material are equalized. When two

[5] Ritchie, T. and H.R. Meincke, Capillary absorption of some Canadian building bricks. National Research Council, Division of Building Research, Ottawa. NRC No. 2966. 1953. 16 p.

pieces of different materials are put together the same thing will occur, but the final moisture contents need not be equal though the potentials are. The relationship of the moisture contents will then be determined by the particular potential versus moisture content relationships for the two materials. It is quite possible, for example, to have a brick containing 1% moisture by weight in contact with mortar containing 9% moisture by weight without any flow between them.

Water contained in the air as vapour has various potential levels depending on the degree of saturation, usually described in terms of relative humidity at a given temperature. As is well known, moisture will evaporate from a piece of material saturated with water to the air surrounding it so long as the air is not also saturated with moisture. In this case the moisture leaves the material as vapour but may move to the evaporating plane either as liquid or as vapour, or both, depending on the conditions. When caused to move in a material in this way, the liquid water present can dissolve and carry any salts which are present. Upon evaporation of the liquid water at or below the surface these salts may be deposited.

Potential levels of moisture are also changed by temperature, so that if a piece of material containing water is heated at one end, creating a temperature gradient, water may be caused to flow within the material in the direction of lower temperature. Migration under these conditions occurs, so far as is known, at present, in the vapour state but may be followed by condensation reducing the moisture to the liquid state within the material if the conditions are suitable. Migration of vapour, under a temperature gradient, leads to differences in moisture content throughout the material, and may therefore be accompanied by a liquid movement as well, which may assist or oppose the vapour movement, depending on the conditions.

Some Effects of Moisture Migration

One of the most commonly observed effects of moisture migration is that of the appearance of efflorescence on brick masonry. When conditions are suitable, moisture which has entered the masonry is caused to migrate to the surface as liquid and be evaporated there. Soluble salts already present within the masonry are dissolved by the liquid water present within the masonry and are carried by it and deposited at the evaporating surface. Four things are essential for efflorescence: soluble salts within the masonry, water within the masonry, conditions for migration of liquid to the evaporating surface, and conditions producing evaporation at the surface. The elimination of any one of these will eliminate efflorescence.

Salts which have appeared at the surface are not always readily eliminated by washing or by rain since some of the water reaching the surface initially will be absorbed by the masonry, but will in the meantime have redissolved much of the salt and have carried it back into the masonry

Even more serious effects are believed to be possible
to appear again later when conditions are suitable.
when under conditions similar to those which produce efflorescence, the evaporating plane occurs within the material. Forces may then be produced by the salt crystals growing within the material as the water is evaporated which are capable of disrupting the material and causing it to spall. This effect is not unlike that produced by wetting and freezing and it is difficult to tell in many cases which mechanism may have been responsible for spalling of a material.

The application of surface coatings may frequently create conditions resulting in the creation of an evaporation plane beneath the coating, or even within the base material. In the former case, the coating may eventually be forced from the surface by crystal growth, and in the latter, the surface material may be caused to spall, carrying the surface coating with it. It is most likely that many cases of failure of surface coatings are due in part to crystal growth. Of particular concern to some of the workers in this field is the possibility that silicone type surface waterproofers may create spalling conditions. They may stop the movement of liquid water on its way to the surface and force evaporation to take place at a plane within the material, at a distance from the surface determined by the degree of penetration of the surface treatment.

Surface treatments may also lead to complications in another way, by promoting wetting-freezing effects. The application of a coating which seriously interferes with the passage of water vapour may force condensation of water vapour behind the coating and may lead to a high degree of saturation of a surface layer of the base material immediately beneath the coating so that upon subsequent freezing the material is caused to spall. This is believed to be the reason for the serious surface spalling which frequently occurs following the application of oil paints to brickwork. It seems entirely possible that wetting by condensation behind a moisture barrier under temperature gradient conditions will produce a high degree of saturation, which is a condition conducive to disruption by freezing. Further, the saturation is produced close to the surface where freezing can occur readily.

Conclusion

Attention has been drawn to a number of pertinent properties and characteristics of building materials which the designer may presently consider usefully, as well as to a number of other considerations with which little guidance can yet be given. Water is seen to be the great complicating factor which must be studied and understood in dealing with many problems involving stability and durability of building materials.

The above was a paper read at the Annual Assembly of the Royal Architectural Institute of Canada in June, 1955.

Design of Unit Masonry for Weather Resistance

T. Ritchie and W. G. Plewes

Decay, disintegration, or other serious damage has frequently occurred in unit masonry materials on their exposure to the weather, and has often resulted in considerable expense and inconvenience in attempts to remedy the trouble. In the design and construction of masonry buildings, therefore, consideration is necessary not only of structural strength and stability, but also of the durability and weather resistance of the masonry.

The task of the designer involves the important problem of selection of masonry units and mortar which, in themselves, will be durable under the conditions of their use, and which also in combination will produce masonry as durable and weather resistant as the components, for it has happened that very serious troubles have arisen in masonry constructed of units and mortars which individually were of high order of durability.

Certain features of the design of buildings, as well as the properties of the unit masonry materials used, can greatly influence the weather resistance and durability of the masonry.

Durability of Masonry Materials

Many studies have been made to determine the nature of the various processes which cause the decay and disintegration of masonry materials from their exposure to the weather. Almost invariably, the deterioration is associated with and dependent upon, moisture in the materials. This is well illustrated by the action of frost on a damp material, by which water in its pores is converted to ice, the resulting increase in volume of the ice often disrupting or weakening the material.

Many instances of severe decay have been attributed to frost action; therefore assessment of frost resistance is usually considered important in the selection of masonry materials. Resistance to damage from freezing forms the basis of durability requirements in Canadian and United States' specifications for clay and shale building bricks. In these specifications bricks are considered to be suitable for use under severe exposure conditions of dampness and frost if they can withstand, without appreciable change, 50 cycles of a freezing and thawing treatment while damp.

Certain properties of bricks are related to resistance to frost action. These are the properties of saturation coefficient (which is the ratio of easily filled to total pore volume), water absorption, and compressive strength. Correlation between these properties in combination, and the resistance of bricks to damage from freezing and thawing 50 times when damp has been established. Therefore in determining these properties a reasonably reliable indication of the resistance of the bricks to the freezing test may be obtained, and according to present specifications the bricks may be assessed on the basis of the freezing test or by the determination of the physical properties of saturation coefficient, water absorption, and compressive strength.

Existing specifications, which have as the basis of their durability requirements resistance to damage from frost, may be considered in the selection of bricks to give reasonable assurance of their durability for the conditions of use.

If bricks are selected solely on the basis of durability, preference will likely be given to those which are the most dense, the strongest, and the hardest-burned, since such bricks are usually most durable. However, as will be discussed later, such bricks may be lacking in properties which will give good bonding between brick and mortar and the durability of the brick and mortar assembly may be very low as a consequence.

The resistance of masonry mortars to damage from freezing and thawing when determined for the mortar alone depends greatly on the composition. Mortars are composed of a cementing material and sand. In modern masonry construction the cementing material is frequently a mixture of portland cement and lime. The resistance to frost damage of such mortars increases as the proportion of portland cement is increased. From the point of view of maximum frost resistance of mortar itself therefore, the cementing material of the mortar should contain a maximum of portland cement. However, other equally important properties in mortars set contrary requirements on mortar composition and it is usually necessary to set a limit on the proportion of portland cement in the mortar.

The selection of masonry materials requires not only that they be in themselves durable, but also that they can be combined to form a durable assembly. If an integral combination is not obtained rain may penetrate into it and the freezing of moisture in the masonry may disrupt it even if the masonry units and mortar individually are highly durable.

Rain Penetration of Unit Masonry

Second only to the problem of selecting masonry units and mortar which are durable in themselves, is that of

achieving an assembly of them which is resistant to moisture penetration, and which therefore overcomes the major factor in decay. Rain leakage of unit masonry is also a problem that often causes much inconvenience from the undesirable conditions it creates inside the building.

Dampness in walls may be caused by ground moisture rising into the walls by capillary forces, or by condensation of water vapour inside the walls or on the wall surfaces. Not infrequently, however, dampness is caused by the penetration of rain through the masonry, and when rain falls on the surface of a wall, penetration to the inside may take place by movement of the water through the body of the masonry units or mortar, and by water movement through cracks or openings in the masonry.

Even though almost all common masonry materials are porous and therefore water may find its way through them at some rate, there is general agreement among those who have studied the problem of rain penetration of unit masonry walls that leakage occurs almost always as a result of water travelling through cracks, separations, or other openings in the masonry, rather than by actual passage of water through the units or mortar. Observations of masonry walls of buildings during rain storms, simulated wind-driven rain tests on masonry panels, and examination of masonry dismantled after dyed water had penetrated it, have shown this.

These experiences of the occurrence of the problem have been summarized as follows, "Penetration of rain through brickwork nearly always occurs through fine cracks between the mortar and bricks and it is rare for the materials themselves to be so permeable that water can be blown directly through them. Resistance to penetration of rain depends therefore on getting tight joints and a good bond between the mortar and the building unit, whether it be brick, block or stone"[1].

In the case of brick masonry a common misconception is that by using very dense, impervious bricks and mortar the resulting masonry will also be impervious to rain. On the contrary, it has often been found that such brickwork may be seriously affected by leakage.

Cracks or openings may be the result of faulty or careless technique in the construction of the masonry, of settlement or other movement in a building, or the result of inability of masonry units and mortar to develop and retain bond or adhesion together.

In the case of brick masonry, two early investigators of the problem of leakage noted that, ". . . a poor extent of bond may be obtained with certain combinations of bricks and mortars simply because the two materials are not well suited to one another"[2].

Properties of Masonry Mortars

Cementing materials known as masonry cements are used also in making masonry mortar. These cements have no defined composition and are variable in properties. Because of this, and on account of the limited information available on the performance of masonry made of this type of mortar, only those mortars of the portland cement and lime types will be dealt with.

The properties of masonry mortars vary greatly with composition. Mortars of portland cement and sand, or containing in addition only a relatively small amount of lime, generally quickly develop, in themselves, considerable hardness and strength, while lime mortars are, in themselves, relatively much weaker and slower to develop strength.

Studies made at the Building Research Station of Great Britain[3], and elsewhere, have shown that mortars of portland cement and sand have crushing strengths of the order of 3,000 pounds per square inch. This diminishes as lime is added to mortar in replacement of the portland cement and the crushing strength of lime and sand mortars is only about 200 or 300 pounds per square inch.

The compressive strength of brickwork does not increase in direct proportion to the strength of the mortar used, so that in many cases little advantage in strength of brickwork results from the use of very strong mortar.

Studies have shown[3] that the crushing strength of brickwork piers of medium-strength bricks laid in very strong mortar (over 2,000 pounds per square inch compressive strength) is of the order of 2,000 pounds per square inch, while that of similar piers of the same bricks laid in a weak mortar (of compressive strength less than 500 pounds per square inch) is of the order of 1500 pounds per square inch. An increase in mortar strength greater than four-fold increased the brickwork strength by about one-third. In any event, the loading on brick walls in which even the weakest of masonry mortars is used, probably would approach the maximum compressive strength of the masonry only under exceptional circumstances.

The elastic properties of masonry mortars vary considerably with composition. The modulus of elasticity of portland cement and sand mortars is of the order of 3 to 4 million pounds per square inch, while that of lime and sand mortars is about 500,000 pounds per square inch. In accommodation of differential movements in the components of unit masonry walls, the elastic properties of the mortar are important.

The dimensional changes which mortars undergo as a result of their hardening and loss of water to an absorbent brick, and subsequently as a result of thermal change or change in moisture content, differ widely among various mortars and also between mortars and bricks. These differences may be such that large enough stresses between mortar and brick are set up to break the adhesion between them. The relatively high shrinkage of portland cement mortars when placed in contact with absorbent bricks and on subsequent hardening and drying was considered by many to be the cause of numerous fine cracks often observed between bricks and mortar, when such mortars were used.

To obtain integral brick masonry, therefore, sufficient adhesion between mortar and brick must be established to withstand the differential dimensional changes between them which tend to cause separations.

Certain mortar properties influence greatly the nature of the bond between brick and mortar, particularly the extent or completeness of the bond which is developed between the two. In this respect the mortar properties of workability and water-retaining capacity are particularly important.

The water-retaining capacity is the ability of the mortar

to retain its moisture when placed in contact with an absorbent brick. A standard method of measuring this property is to compare the extent of flow or spread of the mortar when jarred on a flat table, before and after it has been subjected to a suction tending to withdraw moisture from it in the same manner as an absorptive brick.

The differences in the property of workability in mortars of various compositions are readily appreciated. There is as yet, however, no standard method of quantitative measurement.

Both these properties depend on the composition of the mortar, and it is found that mortars high in water retention are generally of good workability.

Mortar composed of portland cement and sand is characterized by harsh working properties and relatively low capacity to retain moisture against the suction of an absorbent brick. On the other hand, mortars composed of lime and sand are usually high in water-retaining capacity and have excellent working qualities. Therefore the properties of water retentiveness and workability are benefited by increasing the proportion of lime. The beneficial effects vary however, with the type of lime. Lime putty obtained from slaked quicklime contributes most to workability and water retention. Putty of soaked hydrated lime is generally less beneficial in this respect, and hydrated limes mixed dry into the mortar often contribute no more to the workability and water retention than portland cement.

Influence of Brick Properties on Bond

The properties of bricks, as well as those of the mortar, can influence the nature of the bond between them.

This is well illustrated by reference to the results of studies of the strength in tension of the bond between bricks and mortars. The first studies of this were probably made at the United States' National Bureau of Standards [2,4]. Although strength of bond is not a proper criterion of the suitability of a particular brick and mortar combination from the point of view of its rain resistance, studies of it have revealed the influence of certain properties of bricks, and mortar, on the nature of the bond.

The initial rate of water absorption or suction has been found to be an important property of bricks in relation to the nature of their bond with mortar. A standard method of measuring this property has been developed, by which the brick is placed in water to a depth of ⅛-inch for one minute, and the weight in grams of water absorbed, for a brick area of 30 square inches, is called the initial rate of water absorption or suction.

Fig. 1, taken from reports of studies at the United States' National Bureau of Standards[2], shows the effect of brick suction on strength of bond in tension between bricks and mortar for various mortar compositions. It is seen that in all cases, and other studies have given similar results, for increasing initial rate of absorption or suction of the bricks the strength of bond increases to a maximum and then decreases. The maximum occurs at initial rate of absorption of about 20 grams, that is, when bricks absorb about 20 grams of water when set in ⅛-inch of water for one minute.

The suction of bricks can be reduced by wetting them, and it can be seen in Fig. 1 that bricks of high suction when wetted a suitable amount can have a suction value imparted to them which will give maximum bond strength. Wetting can, in some cases, reduce the suction to a degree that lower strength of bond from that obtained with the dry brick is obtained. In any event it is a practice difficult to control accurately on the construction site to obtain uniform results.

Extent of Bond

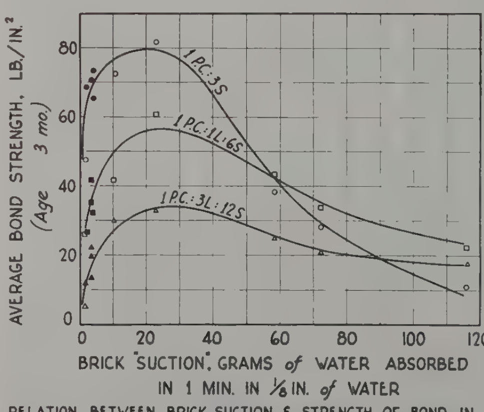
In regard to the rain resistance of brickwork, it has been found that completeness of the area of contact or adhesion between brick and mortar is an essential requirement.

That some combinations of bricks and mortars are much more suitable than others in the extent of bond developed, has been well demonstrated by a study made of the extent of cracking or lack of adhesion between brick and mortar at the exposed surface of brick walls of many buildings.

This study by C. C. Connor[5], an early investigator in the United States of the problem of rain penetration of brick walls, involved measurements of the total linear amount of visible cracks or separations in areas of the brickwork of the buildings, and the amounts were expressed as a percentage of the total mortar joint length in the area examined. In this study it was found that "the amount of visible separation cracking in brick panels at each building was measured and was found to vary between 2.5 and 68.3 per cent with an average of 31.1 per cent", and it was further noted that "if this average of cracking existed throughout the walls of a moderate-sized two-storey brick building having 10,000 sq. ft. of exposed brick walls, there would be about three miles of cracks".

The rate of water absorption of the bricks used and the composition of the mortar were indicated in this study to be related to the extent of adhesion developed between brick and mortar. With all types of bricks the extent of adhesion was better when mortars high in lime content were used. The lack of adhesion between brick and mortar was less extensive also when bricks low or moderate in rate of absorption were used and increased in amount when bricks very low, high, and very high in rate of absorption were used. This lack of adhesion between brick and mortar was consistently least when combinations of bricks of low or moderate rate of absorption and mortars high in lime content were used.

In a later study of these buildings and others from the



RELATION BETWEEN BRICK SUCTION & STRENGTH OF BOND IN TENSION

Fig. 1

point of view of resistance to rain penetration (they were situated in an area of the United States in which this was considered a serious problem), it was found that the properties of bricks and mortars similarly influenced the resistance of the buildings to rain penetration.

The use of bricks of moderate rate of water absorption (between 5 and 25 grams when the brick was placed in ⅛-inch of water for one minute) and the use of mortars of lime content at least equal to one-half the volume of portland cement, were found to be factors highly favourable in the rain resistance of the brickwork.

If bricks of other rates of absorption and mortars higher in content of portland cement were used, it was considered that detrimental factors were introduced in the resistance of the brickwork to rain penetration.

Construction and Design Details

No unit masonry can be expected to withstand repeated and severe saturation from water directed on to it in concentrated amounts. It is common to find deterioration where copings and sills or other details of faulty design have drained water on to the masonry instead of performing their function of directing it away from the wall. Localized areas thus saturated are highly susceptible to frost deterioration, chemical deterioration, or efflorescence.

The type of wall construction used and certain details of the type of workmanship specified are also important factors in the weather resistance of masonry. Even good materials cannot perform well if the wall construction is at fault.

Joint Filling

Considering first of all the details of the brickwork itself, there is general agreement among authorities that the most important factor in the water resistance of masonry walls is the filling of the joints. It is evident that lack of care in filling the joints leads to voids and through channels in the brickwork through which water may flow. The durability may also be affected. If water collected in such voids freezes the wall will be liable to disruption regardless of the durability of the materials tested individually.

Tests have shown excessive leakage where the type of construction sometimes used by speculative builders is employed. In this method the mortar is used sparingly, the bed joints are deeply furrowed and the head joints are but lightly buttered at the outside corners with only enough mortar to maintain the outside appearance of the building. The interior vertical joints in this type of wall are left unfilled. Such brick walls are highly permeable for all types of bricks, mortars and wall thicknesses.

There are several methods of constructing solidly filled joints which produce satisfactory results. In one such method the mortar for the bed joint is spread to a uniform thickness or only lightly furrowed. The head joints are formed by heavily buttering the ends of stretcher bricks and the edges of header bricks before they are placed. The filling of the collar joints is completed by slushing the mortar in from above. Other methods of filling the joints are by pouring in grout or by shoving the brick with a sideways motion into a heap of mortar placed on the bed (pick-and-dip method). Grouting appears to be the least reliable of the three.

Wall Thickness

Wall thickness is of course an important factor as well. It has been found that where a wall is composed of two or more thicknesses of units the intervening mortar joint acts as a barrier to the penetration of water. For instance water penetrates the continuous paths through header bricks many times as quickly as it takes to pass through two stretches and a mortar joint. This does not necessarily mean that the mortar is less permeable than the brick. It means that the penetration time of the two materials in combination is not an additive function of the times taken to penetrate them separately.

Wall thickness is also effective in other ways. Porous materials will absorb water when wetted by rain and will evaporate it in dry weather. Penetration will occur when the wall is saturated so that the permeability of a wall depends to some extent on its capacity to act as a reservoir, which is a function of its thickness as well as its porosity. Wall thickness also delays penetration by reducing the probabilities of cracks or openings being continuous through the wall.

A wall of dense, impervious units and mortar will absorb very little water from a rain. Owing to the nonabsorptive properties of the material, however, water may penetrate any cracks or openings in the wall practically unhindered. Watertightness depends on tight bond and meticulous workmanship to eliminate cracks and openings through which water may pass. The thickness of the wall is again an important factor in reducing the number of opportunities for water penetration.

These are some of the essential factors in the rain resistance of masonry walls but there are as yet no guides by which a designer can use them directly to choose a wall thickness. Numerous tests have, however, been carried out to determine by test the effect of thickness on the permeability of masonry test panels. The most extensive of these were carried out at the U.S. Bureau of Standards[6,7] and some of their conclusions were as follows:

(1) If the interior joints of the brickwork are left open, both 8- and 12-inch integral walls are highly permeable to driving rain and there is no consistent correlation between leakage and the absorptive properties of the bricks;
(2) Where the workmanship is poor there is little advantage in a 12-inch wall over an 8-inch wall;
(3) *By a suitable selection of brick and mortar properties* an 8-inch wall may be adequate.

It is fair to say that the above conclusions were arrived at from laboratory tests on relatively small test panels. C. C. Connor of the New Jersey Bell Telephone Co.[8], made a survey of 93 brick buildings under his supervision and concluded that if other factors were favourable a 12-inch thickness of wall is necessary to provide sufficient rain resistance under severe conditions. It may well be that under job conditions some accidents of workmanship are unavoidable and even when the materials are selected with care a 12-inch wall is desirable. The same observer reported that where conditions such as brick properties and

workmanship were not favourable, walls up to 20 inches in thickness had leaked.

Effect of Header Bricks

Where bricks are very porous, header bricks tend to increase the permeability of 8-inch walls by providing a direct connection between the inner and outer faces of the wall. This normally occurs only when the rain is unusually heavy or persistent but it may sometimes be observed in new walls when rain falls on brickwork that already contains considerable moisture from construction.

Tests have been made in which two wythes were bonded together with metal ties instead of headers. It was found that there was little difference in the methods of bonding with low or medium absorption bricks but for walls made of high absorption bricks the permeabilities were less.

Effect of Back-up Material

Walls built with low absorptive facing wythes and highly absorptive back-up wythes have also been tested[6]. Results indicate that when all the joints are filled with mortar such walls are less permeable than those with all-high or all-low absorption bricks. The effect appears to be that an impervious facing reduces the amount of water penetrating to the wall interior and the porous back-up tends to delay any water that penetrates the exterior facing in its passage to the back face of the wall. Where the workmanship was characterized by unfilled interior joints the absorbent backing was effective in reducing wall permeability only when the test conditions were not severe. Some authorities[9,10] are of the opinion that if the facing wythe is made of materials that are too impermeable, any water getting into the wall may be trapped and increase the danger of damage by frost action.

It was found by some that there was no evidence that walls of brick backed with hollow tile or concrete block were inferior to solid brick walls with regard to rain resistance[8,11]. Others have found that solid brick walls give slightly more consistent performance than walls with backings of hollow units, but that with filled interior joints and a relatively high rain resistance to the facing the difference is not likely to be great[6]. There is reason to believe however, that these findings should be accepted with reservations in parts of Canada where wet weather is often followed by severe freezing. Water has been known to accumulate in the cavities of hollow units causing disruption of the wall when freezing occurred.

Joint Tooling

A method of joint tooling is frequently chosen for the appearance it gives to the brickwork but from the standpoint of rain penetration concave tooled joints give the greatest resistance. Cut-flush, struck or raked joints, although they have their place, should not be used for buildings subject to wind-driven rain. Forming such joints tends to draw the mortar away from the units, whereas in forming concave joints the mortar is compressed and a firm bond created between the unit and the mortar at the face of the wall. The surface is also excellent for the shedding of water. Joint tooling is not, however, so important as the workmanship inside the wall.

Parging and Stucco

The U.S. Bureau of Standards conducted tests on brick and hollow masonry walls in which stucco or parging was used in the construction in various ways[6,7,12].

Masonry test walls of hollow tile with stucco facings were found to be superior to brick-faced walls when new, but after three years outdoor exposure cracking of the stucco reduced their effectiveness to about that of an 8-inch brick wall.

Four-inch test walls with ½ inch of mortar parging on the back were about equal to 8-inch solid walls with solidly filled joints when new. After a few years of outdoor exposure, however, cracking of the parging caused them to leak excessively.

A third series of tests was made to study walls in which a parge coat was applied to the back of the facing wythe or to the back-up wythe to act as a dam in preventing the passage of water through the wall. An ⅛-inch space was left between the parging and the opposite wythe. This type of construction might have particular application where there is not likely to be sufficient building inspection on the job to ensure filled joints. It is frequently used where hollow tile is the back-up material. Such a parge coat is discontinuous at the header courses and it was found that, unless the joints at the headers were completely filled with mortar, the passage of water through the walls was not effectively stopped. When this was done the results were quite satisfactory. No data are yet available to indicate what the performance of such walls is likely to be, if, after a few years of exposure, cracks occur in the parging.

Protection of Brickwork

The degree of protection that can often be afforded masonry structures by flashing, weathering and caulking can well be emphasized.

It is generally agreed that all horizontal surfaces where water is likely to accumulate should be weathered and preferably flashed as well. The concentration of water where a nonabsorbent surface drains onto brickwork is likely to cause leakage, deterioration, or staining. For this reason sills and copings are usually projected from the wall and provided with adequate drips. If such sills and copings are not all of one piece or are of porous material they should be provided with through flashings which cut them off completely from the wall. Belt courses, window and door heads, expansion joints and the junction of roofs with masonry walls are other typical places that require flashing.

The top of a parapet is one of the most vulnerable points in a building for the entry of water into a wall. It is necessary to provide either a continuous, overhanging, impermeable coping, or, if the parapet has joints or is of porous material a through flashing should be provided below it. If possible, through flashings should project beyond the face of the wall and be turned downwards to form a drip.

The parapet may still be frequently saturated by rain from the sides and the water may percolate downwards into the building. To prevent this it is recommended that

a through flashing be placed near the roofline also. This is usually a continuation of the counter flashing to the roofing material which is carried up the parapet wall high enough to retain any water impounded on the roof. The brickwork on the back of a parapet should be equally as durable and watertight as that used on the face and should not be made of inferior material as is sometimes the case.

At least one authority[8] has stated that it is good practice to cover the back of a parapet with a felt or metal covering. Others[13,14,17] claim that if the rear side is covered water can still enter on the other and because of the covering on one side the parapet may not dry out readily and thus becomes subject to frost action. The weight of opinion seems to be against such a covering but the matter warrants further study.

Since parapets are severely exposed and are often saturated, they are sometimes made hollow with weepholes draining to the roof just above a flashing at its base[9]. This is believed to keep the parapet drier and less liable to deterioration. The idea seems to have some merit.

It is commonly recommended practice to install an asphalt membrane covering at spandrel beams to form a cut-off through the walls at floor and roof levels. This is put in because the brickwork is thinner at the beams than in the rest of the wall and to prevent water from entering at these points where cracking is likely to occur due to shrinkage of the brickwork or movements of the structural frame.

In Connor's[8] investigation of leakage in nearly 100 buildings it was found that such waterproofing actually promoted cracking by providing a cleavage plane where the membrane turned out to the face of the wall. At the roof spandrel, parapet movements were found to take place along this cleavage plane whereas in buildings without spandrel beam waterproofing, little evidence was seen of parapet movements. Fifty-three of 76 buildings were moisture proof when spandrel waterproofing was not used but only 1 out of 24 when the spandrels were waterproofed. It was the investigator's opinion that spandrel beam waterproofing was a detrimental factor toward obtaining leakproof walls.

F. O. Anderegg[15], one of the earliest investigators of masonry leakage, also acknowledged that sometimes a problem does exist when he stated that shrinkage of masonry wall panels often results in a fine crack just below the spandrel beams. It was his suggestion that a flexible joint might be made at this point out of bituminous material.

This is not sufficient evidence on which to abandon spandrel beam waterproofing in view of the high regard with which it is held by most authorities but it does show that further investigation is needed.

The amount of protection afforded brickwork by an overhanging roof is not always appreciated. Roof overhang is a positive barrier against the entry of water at the top of a wall. In addition, rain very often falls vertically or at only a slight angle and when this is the case large areas of the wall receive very little water if they are protected by eaves. It is particularly important that the eavestroughs and downspouts be adequate to handle the flow from the roof. They must also be kept unobstructed and in good repair. A large amount of disintegration, efflorescence and staining is caused by water from faulty gutters.

Wall Furring

There is no conclusive evidence that furring is necessary on all masonry walls. Authorities practically all agree, however, that it is highly desirable practice in a generally cold climate such as we have in Canada or in areas subject to wind-driven rain. While furring does not prevent leaks in the masonry it does reduce the extent of damage to the plaster when walls are penetrated by moisture. It is true that many walls have been successfully plastered directly on the masonry but the method provides no insurance against any defects in the wall construction.

Cavity Walls

Nothing has heretofore been said about the true cavity wall. In Britain, the British Standard Code of Practice for Brickwork[16] considers this type of wall the only one that will provide reliable rain resistance. Solid walls are not recommended under severe exposure conditions. The following table is taken from the above-mentioned Code.

SUITABILITY OF WALLS FOR VARIOUS EXPOSURES

R — Recommended N — Not Recommended

Construction	Exposure: Sheltered	Moderate	Severe
4½ inch wall	N	N	N
9 inch solid wall	R	N	N
13½ inch solid wall	R	R	N
Rendered solid wall	R	R	N
Cavity wall	R	R	R

Exposure conditions were rated as follows:

Sheltered — Sheltered conditions obtain, for example, in districts of moderately low rainfall where brickwork is protected from the weather by the proximity of buildings of similar or greater height. The first two storeys above ground of buildings in the interior of towns come within this group.

Moderate — Moderate conditions obtain where the exposure is neither sheltered nor severe.

Severe — Severe conditions obtain where brickwork is liable to exposure to a moderate gale of wind accompanied by persistent rain. Brickwork that projects well above surrounding buildings may be severely exposed even if it is not on a hill site or near the coast.

The thinking behind these provisions seems to be that because of the variability of available masonry materials and the difficulty in always obtaining the meticulous care required to build leakproof solid walls, they cannot be depended upon to resist the most severe conditions. In a rain of sufficient duration a solid wall may leak. A cavity wall if properly built, they contend, will provide a positive barrier to rain.

In America, field studies[8] and laboratory tests[7] show that excellent results can be obtained with the cavity wall.

All observers emphasize the need for weepholes and that the cavity should not be bridged across by mortar droppings falling to the bottom or onto the wall ties. Flashings and weepholes are required over all openings which will positively divert water to the outside.

Cavity wall construction cannot be recommended for

Canada without reservations until at least two possibilities have been investigated further. Firstly, in parts of the country very low outdoor temperatures and efficient heating systems set up large temperature differences between the inside and outside of walls. There is evidence that this may result in large differential movements between the inner and outer wythes of a cavity wall. Secondly, the outer wythe of a cavity wall is severely exposed to moisture saturation and possible freezing. In our climate the durability requirements may be so severe as to be not always easily met.

Summary

The design of unit masonry for weather resistance requires consideration of many factors. The materials to be used must be selected from the point of view of their individual durability, and also of obtaining an integral combination, for if this is not achieved serious deterioration can occur in the masonry even if the materials in themselves are highly durable. The design of the building and the masonry also exert considerable influence on its weather resistance.

Under conditions which are severe a high degree of protection against excessive wetting of the masonry may have to be afforded in the design of the building exterior in order to obtain satisfactory service. Weather-resistant walls are not ensured by any single factor. They result from the presence of a combination of favourable factors and the exclusion of those that are unfavourable.

The above was a paper read at the Annual Assembly of the Royal Architectural Institute of Canada in June, 1955.

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Music and the University

Harry Adaskin

I HAVE FOUND, IN MY EXPERIENCE, that what I am going to say today about music in Canada, and specifically about the place of music in the Canadian university, is as true of other countries as it is of ours. Making due allowances for density and size of population, the state of music is practically the same everywhere. People are not more musical outside Canada than inside; the world's greatest composers have died of neglect in the world's great musical capitals just as easily as they would have died here. The three people who followed Mozart to his grave in Vienna, and the dozen or so who did the same for Debussy in Paris, could as easily have been mustered in Toronto.

Actually, we are even more polite. We don't hiss a new symphony by Weinzweig, or create a riot during a new opera by Pentland. We patiently wait until the agony is over, and even applaud a little. Or, at worst, if it's a broadcast, we turn it off in disgust, and write a letter to the *Globe and Mail* expressing our disapproval of using taxpayers' money for such cacophony.

No critic of our time has ever said anything worse about Bartok, Stravinsky, or Schoenberg, than contemporary critics said about Beethoven, Chopin, Brahms or Debussy. (See "Lexicon of Musical Invective" by Slonimsky). The fresher and more original the viewpoint, the stronger and blinder was the opposition. This remains as true today as it was in the past. And it's as true of the other arts as it is of music. Van Gogh practically never sold a picture, and as for Rembrandt, the finer artist he became, the fewer commissions he received. These statements are, of course, an over-simplification of a very complex problem, and like life itself the view is confused by seemingly irreconcilable paradoxes. For occasionally, if rarely, the opposite was true. Dittersdorf was knighted by his royal employer, and Dali and Liberace are millionaires!

What it all comes down to is this: to recognize the good, the beautiful and the true, is very difficult. But the world does not believe that simple fact. After all, they can see, can't they? they can hear, can't they? and does the camera lie? The answer to the first two questions is No, and to the third Yes.

I always remember that the graduating students at an art school were once given an assignment in life-class. They were to do a drawing of a young woman, with special attention to her feet. When the twelve students in the class were finished, the instructor returned to criticize their work. He looked at each drawing in turn and went into gales of laughter. The students were greatly puzzled — the drawings were not funny, and the laughter seemed inappropriate. He finally remarked that the one thing they really go to art school for, which is to learn to see, had not been realized. They look, but they don't see. He asked the model to go up on the platform again, and he pointed to her right foot, which had six perfect toes. Everyone had given her five. They saw with their habits, and not with their eyes.

As for the camera, I think the most photographed person I remember from my youth, was the late Queen Mary. I saw photographs of her walking, standing and sitting, formal and informal, in ships and motor-cars, smiling and serious, bowing and shaking hands, kissing her departing children and welcoming them back, etc., in a thousand different poses. I was as familiar with her appearance as I was with my own mother. I could never mistake that regal, noble bearing, that tall, imposing figure. Many years later I was invited to an intimate garden party at Buckingham Palace, with seven thousand other guests.

I saw a wave of people undulate to the ground with bows and curtseys, like wheat in a field on a windy day. I craned my neck to see who was approaching, and soon saw a frail little old lady, dressed entirely in white, quite tiny, and looking like those fragile porcelain figurines that people put on the mantel piece. I didn't know who she was, but as she came closer I noticed a family resemblance to Queen Mary, whose majestic figure I was hoping to catch a glimpse of. You can imagine my astonishment when I discovered that this delicate, little creature was Queen Mary. Certainly I could have passed her in the street, as many people actually did, without ever suspecting.

As everyone who has ever worked in the arts knows, we do not see, or hear, or understand, without making a prolonged and continuous effort. (It must be continuous because of the constantly changing styles in art). Any modification of this minimum demand impairs the results. Thus you will often hear famous men and women—famous in music—who declare in effect that nothing worthwhile has appeared in music since Brahms. I know a well-known pianist who said to me in 1924 that Brahms was the last of the composers who had anything to say. In 1954, having forgotten what he said thirty years earlier, he assured me that no one has written a worthwhile phrase since De-

bussy. He progressed twenty years in thirty years, and was only forty years behind the times in general! For by the time of Debussy's death, Schoenberg, Bartok and Stravinsky were established masters who had already written works that were to change the whole direction of music forevermore, and Charles Ives' composing career was already over.

If competent musicians who are supposed to know, can talk like that, what can we expect of the general public? These musicians – and I'll name only two, merely to illustrate how very eminent they are: men of genius, Kreisler and Casals – have obviously fulfilled the first demand; they have made a prolonged effort, but not a continuous one. Somewhere along the way they stopped. But art, like life, doesn't stop. It is continually evolving. The man who has said everything in music has not yet been born. Even Beethoven didn't say everything. He left plenty for others to discover and say, and there will be plenty more left for artists of the future. And as the history of criticism shows, every evolutionary change, from Beethoven through Wagner to Schoenberg, has been found shocking, and has aroused the hostility of the majority of the public and critics. Wouldn't you think that this well-documented history would at least teach people ordinary caution that would lead them to view habits as habits and not eternal truths?

A glance over the world's music at any time would show that there are many principles upon which valid music could be based. The tempered-scale-diatonic-harmonic principle of our classical music is not the only one. Oriental peoples have long used other principles as the basis of their music. That is why we find it hard to understand. And in a seemingly infinite universe, is it too much to expect that many new and hitherto unsuspected principles remain to be discovered? How is it that Schoenberg's discovery of the 12-tone system was (again) greeted with such shocked horror? Need we be horrified because Newton's seemingly eternal laws do not fit the nuclear world? The fact that they don't, and that a whole world of new laws must be deduced, doesn't make Newton's laws any the less eternal. For the events that they codify, they may be permanent. The new laws are not a replacement of the old, but rather an addition to a growing field of understanding.

The invention of the 12-tone principle hasn't destroyed tonality, as so many speakers and writers thoughtlessly say. If it were destroyed, it wouldn't exist – but it does exist. Even Schoenberg himself, after developing the 12-tone system, wrote works in conventional harmony. What he really accomplished – he didn't destroy anything; no artist ever destroys any valid thing – was the addition of a new dimension to the world of music. Any open-minded person who has listened to "Wozzeck" realizes that what is stated there, could not possibly have been said in the diatonic system. Therefore it contributes to a broadening of culture, an extension of the realm of awareness. It does not replace previous fields of awareness. The invention of the 12-tone system doesn't mean that Bach and Mozart are obsolete, any more than Newton is obsolete. The C major scale may represent an eternal principle; for all I know the 12-tone system may do the same. An eternal principle doesn't mean an only principle. In an infinite universe, can there not be several or many principles co-eternal, each valid in its own field?

This rhetorical question, which surely can have only one answer, brings me to the central point of my talk, which is, the Problem of Valid Education in Art. From observing, over a lifetime, the general public reaction to the questions I have just touched on, there can be only one conclusion: we do not properly educate our students. That anyone can graduate from a high school or a university anywhere in the world, and be unaware that, in the arts, the last word has not been said, and that much remains to be discovered, must surely be the greatest indictment of our methods of education. Surely without such an awareness, no education can be of real value. One could say of that, what Barrie said of charm in a woman: that if she has it, it doesn't matter what else she lacks, and if she hasn't it, it doesn't matter what else she has.

Conservatories of music are as much to blame in this matter as high schools and universities. Music schools teach their students to play the piano or the violin, and when these students graduate they begin to make the appalling discovery that they know nothing about music.

Since being a master of the violin, voice or piano, can go comfortably with an ignorance of music, the reverse, fortunately, is also true. An appreciation and understanding of the arts can be achieved by people who don't know a canvas from an easel, or a note from a fly speck. The craft is only necessary for the producers of art; it is not an essential for consumers. One doesn't need to be a writer to appreciate a good book, any more than one needs to eat the whole of an egg to know if it's rotten. Art is the expression of states of human feeling, which cover an ever-widening range, from primitive music, or jazz, which appeals to the lower nerve-centres – a kind of muscle-music, the effects of which can be easily observed when young people are listening to a juke-box – to a contemplation of, and a communion with, the deepest mysteries of being. It's obvious that the latter cannot appeal to the lovers of the former. And only the aesthetically uneducated can believe that a love of jazz can lead one to a love of the last quartets of Beethoven, or a Dithyramb of Stravinsky. Many can, and sometimes do, make that journey, but they are motivated and led by something quite different. And that "something" is the same lure which leads anyone to a love and recognition of the good, the beautiful and the true.

The important word here, is "recognition." For art springs from the depths of the human soul, and more of us than do should recognize our kinship with it, and recognize it sooner. It's not good enough to recognize Mozart seventy years after he's dead, for by that time there are others in need of recognition. And this time-lag is damaging to the world's artists and to ourselves. For this inability to recognize the real is what fills our radio and TV with such tripe. Now it's my theory that we can enlarge the audience for good music, by right education. It has been estimated by the most reliable authorities that the public which habitually attends the best concerts, is in the neighborhood of ½ of 1 per cent of the population. My own observations over a lifetime of concert-going (and

concert-giving) lead me to a somewhat smaller percentage, but let us accept the larger one. The reason why we have such a small audience for the best music (which, by the way, doesn't cost any more to produce than the cheapest music) is that people don't understand art. One has only to listen to their comments as they are leaving a concert, or an art exhibition, to realize that they have no notion what it was all about. And those are the ones who took the trouble to go! How charming art must be, when even such slight acquaintance is enticing!

But the purpose of art is precisely: to be understood. The efforts of Rembrandt and Picasso, Beethoven and Bartok, are precisely to make clear what, without their efforts would remain obscure. Don't let anyone ever tell you that art can only be felt but not understood. People who say that, are either talking without thinking – not an unknown phenomenon – or don't understand art themselves. The fact that they may be eminent painters or performers has nothing to do with the case, as mentioned earlier.

Now, one can teach any willing person to understand art. There is no obscure art – that is in fact an impossibility. There are, of course, ideas so complex, that they are difficult to grasp. But that doesn't mean that art is difficult. Art may make a statement that needs to be pondered. But it's the statement that's difficult and not the language.

Art, far from being obscure, is the most clarifying of all forms of utterance. But one must learn its grammar and syntax. And I maintain that anyone who is willing can do so. We know from experience that we cannot teach an understanding of art to everybody, simply because everybody is not willing. But I believe that with an effort we can find enough willing students to double – no, I'll be completely and optimistically frank – triple our present audience. We can bring it up to the grand total of one and one-half percent of the population! Don't think this is an inconsiderable gain. It means that every well-attended concert of good music would have to be given three times instead of once. It means that a symphony orchestra, or an opera company, could, without extra rehearsal – and that's where much of the cost is – give three performances instead of one. That would go a long way towards wiping out the annual deficit. Such a large and enlightened public would never allow merely one radio performance of a new and difficult work. They would need, and want, four or five repetitions so that they could clearly understand what the composer was saying. They would write to the *Globe and Mail* to complain of the misuse of taxpayers' money because they were offered only a single performance, which is almost useless when it concerns a difficult work.

Now, our educational institutions are uniquely qualified to offer our people this service. We can teach them to understand, and therefore to appreciate and love art. We can train teachers to go out into the community, into the public and high schools to teach students to understand art.

Don't be misled by pollyanna propaganda – we are not doing that now. I know there are choruses and bands in many schools, but that is not how you learn to understand music. Music is something else, and must be taught as such. It has nothing to do with singing, or tootling on a horn. These singers and tootlers do not become music lovers, and rightly so, because they never learn what music is. And they are taught by teachers who have never learned what music is. I know, because they come to my classes. Playing the euphonium part in Zampa will teach you as much about music as running the elevator in a hospital will teach you about surgery.

High schools and universities should not attempt to produce singers and violinists and composers. They should produce audiences—cultivated art lovers and music lovers. Those who wish to be violinists and pianists must study in trade-schools, for theirs is a difficult craft which can only be mastered through a full-time effort. But their efforts are useless if there is no audience. I look with a worried eye on the hundreds of music schools churning out more and more trained craftsmen without an apparent thought about their students' future.

No one has yet complained that there are too many doctors. Yet medical schools are highly restrictive, perhaps occasionally unfairly so, of their numbers of students. And their graduates have no shortage of "audience." In music we do just the reverse – we do nothing about creating an audience, but everything, in the way of scholarships and other inducements, to create more jobless musicians.

Why is such a state of affairs allowed to continue? It's allowed because there is an ingrained belief on the part of the public that an appreciation of art needn't be taught, because everyone has it instinctively. In spite of historic proof to the contrary, that even their own native language has to be laboriously taught, they cling to this belief with the same tenacity that they do to the dream that they can find happiness and security. They hug the illusion that there are short cuts to the good, as there are to the cheap. It's disturbing for them to reflect that they can never possess happiness and security, unless they have enlightenment first. Actually, that road is the true short cut because its destination is sure.

Similarly, it's easier to pretend about art than to love it; it's easier to give airy opinions about modern music than to understand it.

Universities have it in their power to spread enlightenment in this area. But they'll never do it by adding music schools to their campuses. They must create audience schools. No one should leave university without a world of art opened to his consciousness. You can't do that by offering people concerts – you might just as well offer them splendid lectures in Ugric. You have to teach them Ugric first.

It's our privilege and our duty to show that only along this road may we be led to understand what Blake really meant when he said:

To see a world in a grain of sand
And a heaven in a wild flower,
Hold infinity in the palm of your hand
And eternity in an hour.

The above was a paper read at the Annual Meeting of the National Conference of Canadian Universities in June, 1955.

The Visual Arts and the University

R. H. Hubbard

I SUPPOSE I MUST AT THE OUTSET own up to being somewhat of an outsider at this gathering, and perhaps a biased one at that. I am a museum curator and no longer a university lecturer, and I dare to speak in your presence only because we in the museum field also have a heavy stake in the subject under discussion, at least in so far as it affects professional training in our own field. My own point of view, of course, is weighted quite definitely on the side of art history; but this will not, I trust, make what I say entirely disagreeable to my colleagues in the field of practical art education. For their benefit I hasten to say that many of my 'received' doctrines have been considerably modified by what I have so far learned of the conditions and needs of the country as a whole.

It would be impossible to begin any discussion on art in Canadian universities without some sort of preface on the situation in foreign universities, for here, as in so many other ways, we have followed the example of older or larger countries. In art we have been particularly affected by developments in the United States, probably because of our dependence on Carnegie assistance in establishing our art programs. But I have limited this necessary introduction to two short sections, the one on the main approaches to art in universities abroad, the other on the fundamental question of the university education of artists.

For many years, the universities of Europe and Britain have admitted only the history of art to their roster of studies. This has been the practice also of most of the older American universities, with one or two notable exceptions. Important faculties of art history have in fact grown up in some of the great universities such as Paris, London and Harvard, to say nothing of the German universities. Their avowed purpose is to demonstrate the role of the arts in the history of civilization, with the training of scholars and museum staff as their more immediate end. Artist training in these countries is left entirely to the academies.

But some American colleges and universities, particularly the state foundations, quite early admitted practical art teaching into their faculties of education (which often include the functions of our technical teachers' training schools). Not intended at first to be art schools but to train art teachers, they have in fact become university schools of art. In such places art history is usually left safely within the sanctum of the liberal arts college. But, in recent years, several rather bold experiments have been made in uniting history and practice in one department. Here, by sheer dint of number of students, the stress has come to be on the practical, and the trend has been to secure famous artists rather than famous scholars for the staff.

A further note on these large-scale American university art schools is necessary if only to explain their reason for being and their essential character. They have usually arisen in regions where independent academies of art did not or would not flourish, as in some of the central agricultural states. In these circumstances, the only alternative to a vacuum or what is almost as bad, the dispirited provincialism of local art schools, was to afford to the training of artists the protection and prestige of the state university. And so it would be foolish to condemn them or to minimize their achievements made against considerable odds. But the whole arrangement has some real attendant dangers – dangers not only to the intellectual from the practical but also to the creative individual from his contacts with the theoretician.

This leads directly to the fundamental question of whether or not the artist should be educated in a university – a subject of heated debate over some fifteen years in the United States. Here I can only echo one or two of the points in this argument which may be found in the back files of the *College Art Journal*. First, to continue a little further with the creative individual: almost anyone has stories to show that the really serious artist who practises and teaches his art in the university is often like a fish out of water amid the welter of academic analysis and speculation. I well remember the minor explosion that occurred at the University of Wisconsin when a famous satirical novelist arrived to join the English department and was immediately dissected – in only the customary and ritual way – by all members of the faculty, and their wives: he lasted only a month and left to begin a new novel angrier than the rest – and you can guess the subject. And you will remember the fun there was in Mary McCarthy's *The Groves of Academe* when a smallish university engaged not one but a whole symposium of poets.

Then, secondly, to look at the 'products' of this scheme of things: I wonder whether the polished artist-graduate of a four-year course in painting, with which he has combined various academic subjects including the history of art, is really the single-minded individual which his art demands that he be. The multiplicity of his studies may

have been for him not only bewildering but even debilitating. History has its warnings for the artist who knows too much: it is strewn with the skulls of those sixteenth century Italian painters we now call the mannerists and of the eighteenth century English eclectics such as the much-adored Benjamin West (of whom someone made the devastating remark, 'He was a bad painter but a good man'). Both these schools carefully compounded their mixtures of the best they knew of past and present styles, and out of it all came — nothing. It would be tiresome to labour the point that creative minds are intuitive in their grasp of essential things and of some quite elusive quantities like 'the spirit of an age', and do not seem to need an academic education. If a few names of great humanist painters leap to mind, they are the exceptions which prove the rule. The truly versatile Michelangelo is cancelled out by Leonardo who, for all his versatility of mind, is the greatest example of incompleteness in his own craft of painting. Rubens, the best educated of them all, nevertheless supremely possessed the two things which every artist still needs the most: a thorough training in the craft and the visual reservoir of wide travel.

In all of this I am well aware that I have not even touched on matters such as the needs of those important ruling classes of today — what someone has called our 'generals' — the general-course student and the general public. The latter is more properly the problem of the museums, but it includes the amateur artist who may be considered a by-product of the university of today. I have not dealt with these because I am not as yet perfectly sure what all their needs are; and this is perhaps a shocking confession to make, for most of our university programs seem to have taken them quite seriously into consideration. I am sure that some of you will find this omission a serious flaw in my discussion. Of one or two other things I can, however, speak with conviction and admiration: the work of university museums and art galleries and the thrill they have for the young student; and the benefit of special courses in architecture and art (and music) for theological students and others with 'functional' needs — but there is no time here for these details of the general scene.

At last we have background enough to look into the position of art in Canadian universities. To explain to this gathering the situation in all our universities, and in great detail, would be superfluous, so that my description will be brief and in very general terms.

We have, first of all, some universities with departments stressing the history of art. With us the subject is of very recent vintage and is not found much before 1935 in our college calendars. Relatively few offer it at all and still fewer grant degrees in it. This no doubt has been partly due to a lack of demand in the past for its graduates. The fact is that we have only one important centre in the whole country where one may become an art historian. The department of art and archaeology of the University of Toronto offers both pass and honour degrees and specialized graduate work in some fields. Its great emphasis is on history, criticism and theory, but it is interesting to note that even here we in Canada do not perfectly mirror the traditional European attitude of exclusion towards the practical arts. Toronto offers excellent classes in the practice of art, designed to give the student the 'feel' of the craft and a knowledge of historical methods and mediums. Yet the University takes care not to compete with the art schools. As a largish city and a provincial capital Toronto has a well established independent college of art.

In most other universities the courses in art are optional studies. Sometimes these are in the history or appreciation, sometimes in the practice of art. But some universities have or have had artist or art-teacher training programs, and I know that experience here has not always been completely happy. I also know from experience the problem raised by the grading of practical courses in relation to the academic ones. Then there are one or two cases in which universities maintain their own art schools. These are usually schools of some standing in regions removed from metropolitan areas, and they have been attached to universities for the good reasons already mentioned in dealing with the United States. As yet, we have no 'combination' departments on the American plan, though recently one has been mooted for one western Canadian university. Finally, there are universities, including several of the older and more influential ones, with nothing at all in the arts.

That roughly is the present situation, and it shows absolutely no uniformity of plan or pattern throughout the country. Is there, in fact, any single prescription to be recommended for all universities? In saying a most definite 'no' to this question for the present at least, we can, I suppose, only justify it by pointing once more to the great Canadian 'fact'. For with us the form which art education takes in any given university is largely determined by the region in which that university finds itself. As Professor Lower has told us, Canadians accept with a shrug the great linguistic and cultural divisions of their country and proceed to hammer out their many and varied political solutions and compromises. Clearly this applies to the educational as well as to the political sphere. And there are the added monumental problems posed by our widely scattered population, the huge distances between great cities and the lack of a single acknowledged metropolis.

And so, even with my own limited contacts with these realities, I am rather surprised to find myself advocating some things I once deplored, including the taking over by the universities of even more art schools in places where this is essential for their survival and efficiency. For in some regions at any rate we are still in the pioneering era and must be as flexible as possible and welcome every helping hand. But here we can only fall back on an old ally, our traditional conservatism, to have us from excesses.

At the same time, we must recognize, paradoxically, that the struggle for survival is already past in some sections, notably in the great centres. There we must now seriously consider the coordination of our efforts, in order to achieve results of greater uniformity and, above all, greater quality. Therefore in the field of art education in the universities I should like to attach a condition to all future developments: that art history should be universally admitted to our curricula; more than that, she should be enthroned in her own realm, the university. This, I think, would supply the guiding principle and point of unity

which are now lacking. I know that on this point one of our strongest advocates of the 'combination' departments agrees with me to the fullest. With this encouragement and the reassurance that I am not being too narrowly professional, I make bold to proceed to my final point, a plea for art history.

I begin this plea with the further assurance that few administrators, governors or alumni today would consciously deny that art history has its place in the university. It is still, however, considered a luxury by some, and with perhaps some justification. It used to be supported by foundation grants which have now been withdrawn; and the employment prospects, though brightening, do not seem to warrant great expenditures. And so art history continues to operate under handicaps. As a study it is not yet ivy-grown and has not built up a well knit professional brotherhood in Canada. It has its own particular danger zones which the outside observer is likely to magnify overmuch: the dry desert of professional archaeology lies at the one extreme and the slithery places of amateur 'art appreciation', where there is no good foothold except for students searching for what we used to call 'pipe courses' is at the other.

The *via media* of art history — and to my mind the subject at its best — is to be found in the tradition begun in the nineteenth century by the great humanist Jakob Burckhardt and continued by the Swiss art historian Heinrich Wölflin, whose *Principles of Art History* has long suffered from a bad translation but whose pupils and pupils' pupils are numerous today. Thus understood, art history emerges as an intellectual discipline independent of manual skills. It is, in fact, a branch of the humanities and of the age-old study of 'philosophy' in the broadest sense. It is also a study which has shown itself almost endlessly productive of results, not the least of which has been the discovery of methods of describing the phenomena of style — and these it has been able to pass on to other sciences concerned with style. But more fundamentally it is a means of communicating a very important section of our cultural heritage, the entire visual inheritance of man. But it does not stop even there, for it offers us a means not only of understanding the paintings, sculptures and buildings which survive from the past but also of interpreting the whole of our man-made surroundings today, down to the pots and pans in our kitchens or to what the *Architectural Review* has called 'street furniture'. And from there it is only a short jump to the making of practical attempts to improve this environment.

But to achieve in Canada merely what one man, Nikolaus Pevsner, has done for England in his series of architectural atlases will require the discipline of much serious study — no less but no more serious than the study we devote to history, for example. An elective course or two is not enough. Much remains to be done in a field where we have made only a bare beginning. Our trained art historians in the universities can almost be counted on the fingers of one hand; the French-language universities have, I think, only one among them all. In the language of the advertisements, every university (like every housewife) 'should have one', and the larger ones a modest clutch of specialized scholars.

A further personal plea is that one of the French universities establish a centre such as Toronto has supplied for English Canada, and thus relieve the anomalous situation by which there are virtually no French-speaking art historians to be found.

One final point. At this moment our universities and museums are not yet 'geared' to one another. Some museums, though not all, are still looking abroad for their staffs, while our graduates continue to go abroad for jobs. This situation will change, but, in the meantime, the museums including the National Gallery, in anticipation of their expansion and the new posts which will be created, are considering the establishment of their own training scheme. To speak simply for my own institution, however, I should say that we can go only so far in the matter of training on our own without the continued interest and practical cooperation of the universities. Ideally we must work hand in hand. Actually the gap between us is already closing as our graduates become of age to be museum directors — and indeed one did become director of the National Gallery the other day (Mr Alan Jarvis).

The above was a paper read at the Annual Meeting of the National Conference of Canadian Universities in June, 1955.

VIEWPOINT

Do you agree that, for the most part, the heritage of our generation will be cities built and based on promises of quick delivery of plans and cheap structures?

While rapid economic expansion and technological progress remain dominant, it is not to be expected that our cities will show another trend. And if one believes that technology is enough, then the technique of turning out drawings at speed and the development of economy of structure to the limit, are together adequately serving the needs of architecture.

Architecture, however, calls for a somewhat broader sense of responsibility, and unless we can face that responsibility and fight for a sense of values which put the dollar in its place, and fight for the time needed to develop our plans and details to the point where our structures come to life as true works of architecture, we are betraying the trust of our position in society.

Howard Chapman, Toronto

It is understandable that the end of the Industrial Revolution much apprehension will be part of our thinking and planning of our cities. From observation both in Canada and elsewhere there appears to be a great sense of the need of planning. The transition from the Industrial Age and Consolidation of what we have learned will take some time. It is my feeling that great strides have been made in the total concept of planning, it is our obligation to solve these.

A. J. Donahue, Winnipeg

The stress at our particular time and place in civilization appears to be laid on speed and cheapness at the expense of quality. That this outlook is false is to me obvious, for quality implies long term value. The production of quick plans for cheap structures, however, has become the common denominator. There is no question that this tendency is the result of a general philosophy which architects cannot completely counteract, but architects must accept some of the responsibility. How many architects try to get commissions by pointing out that they can build a certain structure at so much a square foot less than anybody else? There appears to be a race to build more cheaply, which, taken to its logical conclusion, will result in everyone designing in concrete block and bar joists. Nothing worthwhile in the way of an architectural heritage could possibly result. In the speculative realm which is responsible for the majority of building in our cities and to which architects can make a valuable contribution, the tendency for quick and cheap plans has been encouraged by a very large number of architects who are doing no service to themselves, to other architects, or to the community. The quality of the resulting architecture can be seen by driving around Toronto. The heritage which we will hand down (except for some very outstanding buildings) will be a sad commentary on our generation. A little more idealism on the part of architects would not be amiss.

Henry Fliess, Toronto

No, I believe that our cities in the future will be, and must be, built under the guidance of an architectural team who will neither sacrifice their professional integrity nor their personal design philosophy for material gain. The future of architecture and therefore, of our cities, depends on what we, as architects, do today. If the practice of quick delivery of plans and cheap structures continues to grow, our cities will be derelict.

The value of one's endeavours is dependant upon the effort applied. Quick delivery of plans means less time spent on our part, which means less control, which, in turn, means less good design.

The value of an object is dependant upon the price paid. (One would hardly expect to purchase a Cadillac for the price of a Ford!) Cheap structure means less use of materials and details which will weather well in our climate, which means costly maintenance or ragged appearance.

This is the basis for the survival of good architecture in our cities and it is through a broadened program of architectural education that the general public is, and will continue to be, more conscious of these facts.

K. H. Foster, Toronto

The question isn't very polite since it is presumptuous to be careful about how things will look later on.

However, the tragedy lurking in this question must be met and conquered, yes indeed.

I have read somewhere of punishments being handed down even unto the third and fourth generation and although this appears to be obviously unjust, it is the case and well brought up people agree. I think you will see that this little observation has taken some of the sting out of this problem, which is so much on our minds today.

John A. MacDonald, Edmonton

NEWS FROM THE INSTITUTE

ONTARIO

Waste in building is caused in many ways — and bad planning, forced elevation treatment, incorrect use of materials, loosely worded specifications, obsolete building codes, all tend to make building costs higher than they should be.

Keeping abreast of developments in the field of structural, mechanical and electrical engineering will help the architect to avoid waste by employing the most advanced proven methods available. As co-ordinator of these services, he must be able to lead in a progressive and enlightened manner.

Professional integrity and contemporary training allow more and more architects the opportunity to express the functions of their buildings and show the component materials; now, architects must train the public to accept the skilful and artistic manifestations of modern architecture, not only as representative of the spirit of this age, but also as preferable to the reiteration of architectural orders of past centuries which were limited by factors no longer

applying. The considerable savings obtained in designing functionally are another instance where architects can assist in curbing waste.

Architects familiar with the horse-and-buggy-day stipulations of some of the Municipal Building Codes in force today should, indeed, welcome the recent revisions of the National Building Code. They should, also, exert their influence wherever possible to have the National Building Code adopted from coast to coast, by every municipality, and work towards a unification of the Code with the host of other codes now existing. A great deal of waste could thus be avoided in time alone — now spent in study of varying requirements.

If such National Building Codes were applicable throughout Canada, a Standing Committee composed of the best technical brains available, could examine all new developments as they arise, and make their findings known to all concerned, at regular intervals, thus eliminating the waste which is involved in working under obsolete restrictions.

Capital expended in buildings is National wealth. Even as rich a nation as Canada cannot afford to squander that wealth. Architects are predestined to assist in avoiding it.

Peter Caspari, Toronto

RIBA PRIZES AND STUDENTSHIPS, 1955 — 1956

The RIBA has issued a pamphlet concerning Prizes and Studentships for the year 1955 — 56. This pamphlet contains full particulars regarding the various Prizes and Studentships including, where applicable, the detailed programs for the competitions.

Copies of the pamphlet may be obtained from the RIBA.

COMPETITION

The Corporation of the City of Ottawa is holding an architectural competition, open to all architects in Canada, for a new City Hall. The proposed location is on the east side of Elgin Street and north side of Albert Street, having a frontage of 258 ft. on Elgin Street and 325 on Albert Street. The estimated square footage requirements for the new City Hall are 78,700 sq. ft. (exclusive of walls, columns, hallways, corridors, stairways, elevator shafts, etc.) and car parking facilities for one hundred and sixty cars.

For the guidance of competitors, the building must not exceed a cost of $2,625,000.00, exclusive of furnishings and architectural fees.

The winner of the competition will be awarded a prize of $5,000.00, and if the construction of the building is proceeded with, will also be awarded the commission to design the building and superintend its construction, and will be paid for his services a fee not less than that provided by the "Schedule of Minimum Charges of the Association of Architects" of the Province of Ontario, but the prize of $5,000.00 will be deducted from such fee. There will be two additional awards of $1,500.00 and $1,000.00 to the two competitors ranking next in order of merit after the winner.

The Board of Assessors will consist of Her Worship, Mayor Charlotte Whitton, CBE; Mr George D. Gibson, B. Arch., MRAIC, President of the Ontario Association of Architects; Mr C. Maxwell Taylor, B. Arch., MRAIC, Building Inspector and Supervising Architect for the City of Ottawa; Mr Gordon C. Medcalf, Q.C., City Solicitor, who shall be Chairman of the Board of Assessors.

All entries must be delivered to the Professional Adviser, not later than 12 o'clock noon, on Wednesday, November 30th, 1955.

The program and general conditions for this competition will be ready for mailing on or about September 15th, to architects who have applied to the Professional Adviser, Mr C. Maxwell Taylor, Room 508, City Hall, 48 Rideau St., Ottawa, before October 28th, 1955, accompanied by a Three Dollar ($3.00) deposit, which will be returned to all those submitting a design.

The owner requires that the winner of the competition shall be in a position to complete architectural and structural drawings so that tenders may be called not later than May 31st, 1956, and work started before October 1956.

CONTRIBUTORS TO THIS ISSUE

Harry Adaskin was born in 1901, and lived most of his life in Toronto. He was a member of the Hart House String Quartet for its first fifteen years, and later was for a few seasons Intermission Commentator on the New York Philharmonic Sunday Afternoon Broadcasts for the CBC in Canada.

Since 1946 he has been Head of the Department of Music at the University of British Columbia.

A feature of his musical activity in Vancouver is the popular annual series of concert-lectures, with his wife Frances Marr, pianist, at which works from Bach to Schoenberg are analyzed, discussed and performed.

Sir Hugh Maxwell Casson, RDI, MA, FRIBA, is the distinguished British architect who was director of architecture for the Festival of Britain and consultant to the City of Westminster in connexion with the Coronation decorations. He was educated at Eastbourne College and St. John's College, Cambridge. In his general practice, Sir Hugh has been responsible for the UK Pavilion, Van Riebeeck Fair, Capetown; the interior design of the Time and Life Building, Bond Street, London; the BOAC Offices, Cairo (with Cockade, Ltd.) and the sets for 'Alceste', Glyndebourne.

Those who heard him will remember with pleasure Sir Hugh's address to the Annual Assembly of the RAIC in 1953.

R. H. Hubbard, Chief Curator of the National Gallery of Canada, Ottawa, studied at McMaster University, in Paris and Brussels for short periods, and at the University of Wisconsin under Dr Oskar Hagen (with a dissertation on early Canadian art). Before his first appointment at the National Gallery, as Curator of Canadian Art (1947), he taught successively at the University of Kansas City, McMaster University, Carleton College, Ottawa, and the University of Toronto. He is a contributor on art and architecture to various periodicals, and a book by him on European paintings in Canadian collections is to be published next year.

Neil B. Hutcheon, Assistant Director of the National Research Council's Division of Building Research, is a native of Rosetown, Saskatchewan, with his Bachelor and Master degrees from the University of Saskatchewan and his Ph. D. from the University of London. He was a member of the staff of the University of Saskatchewan from 1937 to 1953. He was a consultant with the Division from its formation until joining the staff in 1953, with special reference to the DBR Station at Saskatoon. Dr Hutcheon is a member of a number of professional bodies and was President of the Association of Professional Engineers of Saskatchewan in 1945-46.

McDougall & Friedman are Consulting Engineers and have been in business in Montreal since 1921. Amongst the hospitals recently completed are the Montreal Neurological Institute, the Jewish General Hospital and the Royal Edward Laurentian Hospital as well as the new Montreal General Hospital. At the present time, they are working on plans for the Montreal Children's Hospital and the Royal Victoria Hospital.

William George Plewes was born in Russell, Manitoba. He received his B.Sc. degree in civil engineering from the University of Manitoba in 1949 and obtained an M.Sc. degree in civil engineering from Queen's University in 1954. Mr Plewes served with the RCAF from 1941 to 1945. From 1949 to 1952 he was Assistant Engineer in the office of Engineer of Buildings, Canadian National Railways in Winnipeg and was a lecturer at the Royal Military College from 1952 to 1954. Since joining the Division of Building Research, NRC, in June 1954, he has been studying the rain resistance of masonry walls and the development of apparatus for testing the rain resistance of masonry test panels.

Thomas Ritchie joined the staff of the Division of Building Research, NRC, in January 1950. His work in the Materials Section of the Division has involved studies of various problems in the weathering of unit masonry materials. Mr Ritchie graduated in 1949 from the University of Toronto with B.A.Sc. degree in ceramic engineering. Previous to his university course he spent three years in the RCAF as an air navigator.

William Storrar MBE, MB, Ch.B., was born in Scotland and educated at Newstead and the University of Edinburgh. Following internship at the Royal Infirmary of Edinburgh he joined the Imperial Forces in 1940 where he served for five and one-half years in the African Desert and in Italy, and as Director of Medical Services of the British Mission to Greece and as Officer Commanding a general hospital.

He came to Canada in July 1951 and for six months was a member of the staff of the Department of Public Health, Saskatchewan, where he was responsible for hospital and medical services, the medical care program and the Saskatchewan hospital services plan. In addition, he was a Director of the Council for Crippled Children and the Council for Rheumatism and Arthritis for the Province of Saskatchewan and a member of the University Hospital Board, University of Saskatchewan.

Dr Storrar joined the Staff of the Montreal General Hospital three years ago. During the planning and building phases of the new Montreal General Hospital he was appointed as Medical Director. In addition to his hospital duties, he is associated with the Canadian Welfare Council Commission on National Health Insurance and the Care of the Aged and Chronically Sick, is also a member of the Canadian Commission on Nursing and lecturer in the Department of Public Health and Social Medicine of McGill University.

JOURNEY TO PEKING

(continued from page 337)

mac. Unaccountably I am reminded of the war, and of the comforting sound during an air-raid of shunting engines stolidly at work in the distance.

We return to pack, to say goodbye, to take one last nostalgic walk round the Temple of Heaven. The delegation is deep in the genuine sadness of departure, and pricked by pre-travel 'angst'. A Labour Party delegation is ensconced in the dining room, and already our interpreters, we note with irrational irritation, are busy accustoming themselves to a new set of Western idiosyncrasies.

After an airport breakfast of chocolate cake and hot milk – swallowed with some difficulty at 7 a.m., – we shake hands for the last time – two Russian officers embrace warmly and in a few minutes Peking has disappeared into the early morning mists. This time we know what lies ahead. Our intermediate stops are engraved on the memory like the stations on the branch line back to school. Irkutsk passes in a flurry of dead leaves and bitter winds. We fly west and drag darkness interminably in our wake. At Sverdlovsk the interpreter who is learning English by reading Mark Twain asks us the meaning of "High sticks." At Novosibersk an old Tolstoyan character—bearded and booted like an extra from a casting agency—directs the aircraft with hopeless angry gestures. At Moscow we learn of the great local success of the Duke of Wellington. At Leningrad we denude the buffet of caviare. Russia does not so much end as dissolve into the scattered lakes of Finland. We climb, half regretful, half-thankful, into an S.A.S. aircraft and the sybaritism of the decadent West. One last echo of the disciplined East clangs like an iron door in our ears when one of the Soviet passengers declines to fasten his safety belt—"There are no safety belts in the Soviet Union, therefore . . ." The argument to him is unassailable. Soon we are among the glittering sky signs of Stockholm, and next morning we drop through sopping clouds into London Airport. No reception committee, no brass bands, no blandly smiling hosts, not even grudging respect for having got there and back. Great distances, strange passport stamps, exotic labels mean nothing here. The journey is over, the delegation vowing constant friendship to be cemented by regular meetings . . . "I'm in the book . . ." disintegrates instantly into individuality, each with his own private English life and vanishes into London. I wonder if any of us will ever meet again.

The above article has been published with the kind permission of The Observer and the author.

FUTURE ISSUES

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BOOK REVIEW

BOULLEE'S TREATISE ON ARCHITECTURE edited by Helen Rosenau. Published by Alec Tiranti Ltd., London, England. Price 21s.

Tout dans la vie n'est que perpétuel recommencement et si les moyens diffèrent, l'esprit dans la recherche reste animé du même besoin d'élargissement de la connaissance, d'amélioration des méthodes que le progrès dépasse constamment.

Personne ne peut nier le fait que l'architecture contemporaine ne reste pas seulement l'avènement de la machine, qu'elle n'est pas génération spontanée mais bien le résultat de l'accumulation de recherches léguées par les siècles.

Il n'est pas besoin qu'il y ait ressemblance pour que l'on puisse comparer, le phénomène esthétique reste lié au même besoin, à la même compréhension, aux mêmes règles, que ce soit pour le pylone du Temple de Kornak ou pour l'immense stèle qu'est l'édifice des Nations-Unies.

Le Corbusier, ferment de l'architecture contemporaine est un "grand" car s'il a magnifiquement régénéré cette science s'il a tracé le nouveau chemin, il a été aussi celui qui a compris le passé alors que certains l'ignorent, volontairement.

Parlant du Parthénon, Le Corbusier dit:

"Il n'existe rien d'équivalent dans l'Architecture de toute la terre et de tous les temps" (Vers une Architecture, p. 180).

"Depuis deux mille ans, ceux qui ont vu le Parthénon ont senti qu'il y avait là un moment décisif de l'Architecture" (Vers une Architecture p. 180).

Nous sommes actuellement à un moment décisif, à un tournant de l'architecture.

Certains novateurs sont connus, d'autres restent-ignorés, Jean et Pierre de Chelles ont laissé Notre-Dame de Paris; Michel-Ange le Dôme de Florence. Mais qui pourrait dire qui est Boullée? Son nom reste totalement inconnu et pourtant je pourrais presque affirmer qu'il fut le Wright, le Perret, le Le Corbusier du XVIII siècle. Les paroles passent, mais les écrits restent, et il est heureux que ce M. Boullée ait été grand dessinateur et écrivain habile, car il nous est possible maintenant de connaître et ses théories sur l'architecture et ses conceptions.

Nous devons au Docteur Helen Rosenau de l'Université de Manchester d'avoir su se replonger dans le passé pour extraire de l'oubli et des rayons de la Bibliothèque Nationale de Paris les magnifiques dessins et textes du sieur Boullée né en 1728 et mort en 1799.

Nous trouvons dans ce livre le texte original du manuscrit en français, les dessins suivent les notes de l'auteur. Le Dr Rosenau a aussi largement commenté le texte, ce qui rend ce livre très intéressant par le fait que le lecteur trouve en français comme en anglais matière à calmer sa curiosité.

Il est très difficile de commenter un livre tel que celui-ci car il s'agit du résumé d'un résumé.

Je me contenterai donc de vous présenter l'essai sur l'architecture de Boullée, vous laissant la surprise extraordinaire de la lecture du texte sur les différents programmes tels que: Basiliques, Théâtres, Palais, Colisée, Bibliothèque, Cénotaphe, Newton, ponts.

Boullée voulait devenir peintre, mais il suivit les traces de son père qui était alors architecte des Bâtiments du Roi.

Malgré tout, son architecture sera celle d'un poète et d'un philosophe et le peintre verra tout par les lumières et les ombres.

Il vécut pendant les temps troublés de la Révolution, mais son architecture fut plutôt celle d'un réformiste que d'un révolutionnaire et l'on jugea dans ce temps ses opinions comme académiques et royalistes, ce qui ne lui facilita pas la tâche.

Beaucoup de ses dessins sont antérieurs à 1789 et si nous en possédons beaucoup, il a par contre laissé peu de constructions, citons: des hôtels particuliers, dont l'actuel Elysées, à Paris.

Boullée fut un contemporain de Ledoux, Boffrand et Blondel. Il eut sur eux beaucoup d'influence, et si Ledoux fut beaucoup plus connu, c'est peut-être parce qu'il était plus pratique, alors que Boullée était un visionnaire.

Il puise énormément dans l'architecture classique et le Romain traditionnel, luttant sans cesse contre le rococo de son époque, employant des formes exceptionnellement dépouillées (La sphère du Cénotaphe de Wilson).

Nombreux furent les architectes contemporains de Boullée, qui subirent son influence et nous retrouvons certains monuments qui sont fortement inspirés de ses théories, tels que:

La Bourse de Paris,
La Bibliothèque Nationale,
Le Cénotaphe de Newton.

Son influence dépassera la France et nous la retrouvons en Allemagne, en Russie, ses disciples transmettront ses idées et nous les retrouverons plus tard en Angleterre et même aux Etats-Unis. Enfin c'est dans le style Empire que se concrétiseront les grands thèmes de Boullée.

Dans le premier chapitre consacré "aux hommes qui cultivent les Arts", il considère l'architecture à "son aurore", et s'adonnant avec passion à la recherche, il arrivera à cette considération (trop souvent oubliée aujourd'hui) que les édifices devraient être en quelque sorte des poèmes et que "les images qu'ils offrent à nos sens devraient exciter en nous des sentiments analogues à l'usage auquel ces édifices sont consacrés".

Réfutant la définition de Vitruve "l'Architecture, c'est l'art de bâtir", il distingue deux parties "l'Art proprement dit et la Science", et constate que malgré les nombreux ouvrages sur l'architecture aucun ne définit cet Art et "Si l'on parvient à dévoiler l'existence et la source des principes, les principes sont restés ignorés".

Dans un autre chapitre "de l'essence des Corps", il étudie les masses des corps irréguliers "qui échappent notre entendement" et réguliers, dont "l'image est celle de l'évidence même".

Il ajoute "que la variété nous plaît parce qu'elle satisfait un besoin de l'âme qui par sa nature, aime à s'étendre et à embrasser de nouveaux objets. Or les objets se reproduisent sous de nouvelles faces par la variété". Il s'en suit une satisfaction saine et facile, par le fait que le regard embrasse d'un seul coup un ensemble qui est constitué par la répétition d'éléments que d'avance nous acceptons et qui nous réjouit par les couleurs, les éclairages, dans des positions diverses.

C'est en quelque sorte une préface à la recherche contemporaine de l'architecture modulaire.

Boullée affirme ensuite que la première des lois qui constitue les principes de l'architecture "c'est la Symétrie"; cela provient probablement du fait que ses études portaient presque uniquement sur des ensembles pleins de magnificence et de grandeur.

Faussement interprétée, cette assertion pouvait mener à l'académisme et au pompier, ce qui ne manquera pas, telles la plupart des grandes compositions que de nombreux concours nous ont données. La symétrie pour la symétrie offre le même danger, que celui actuel, de la forme pour la forme, aussi irrationnel.

Je pense qu'il serait préférable si l'on désirait transposer l'idée de M. Boullée et lui donner toute sa force, de dire équilibre, plutôt que symétrie.

Cette dérogation faite aux principes de l'auteur, nous pourrons être, à nouveau, pleinement d'accord avec lui en terminant par cette phrase qu'il nous livre dans ce qu'il appelle "l'examen de l'assertion" "Le compas de la raison ne doit jamais abandonner le génie de l'Architecte qui doit toujours prendre pour règle, cette maxime "*Rien de Beau, si tout n'est sage*".

André Blouin